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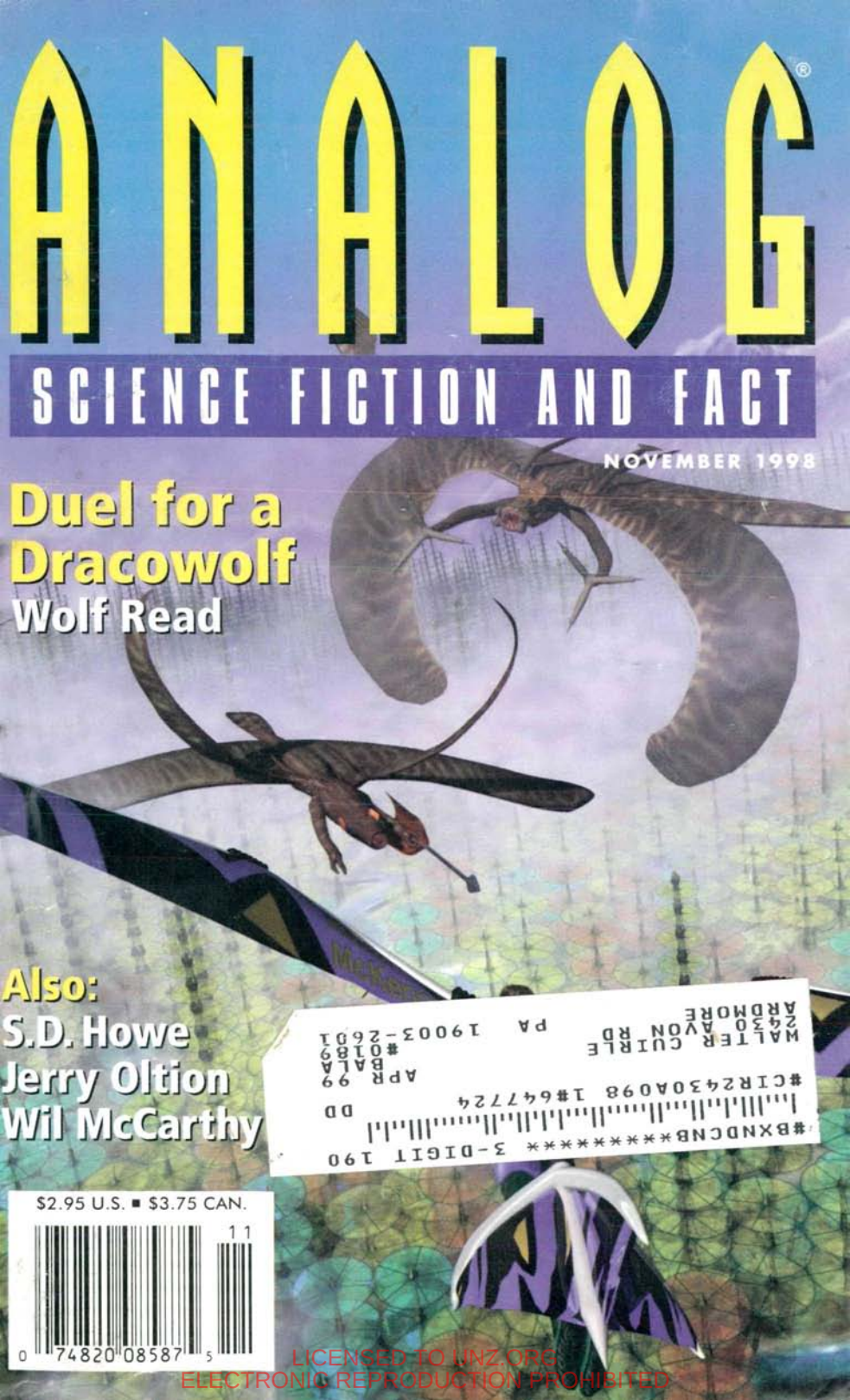

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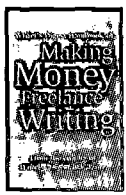

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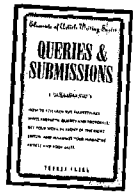

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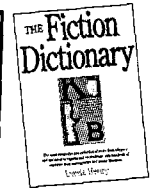

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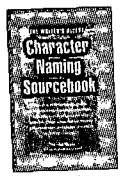

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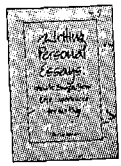

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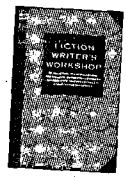

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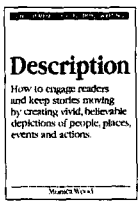
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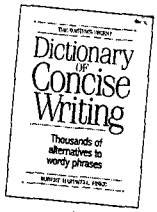

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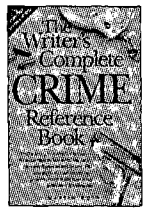

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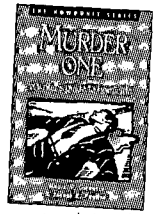

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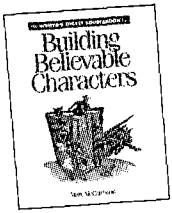

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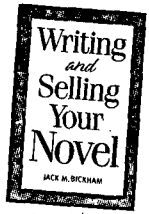

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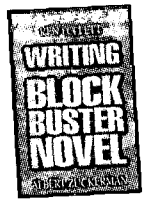

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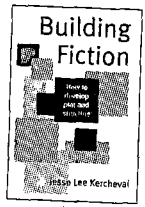

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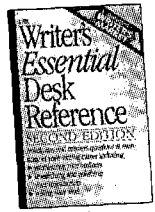

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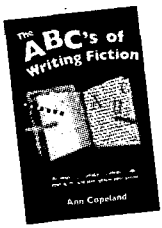

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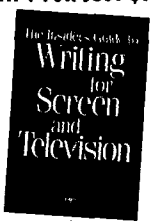

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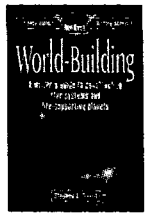

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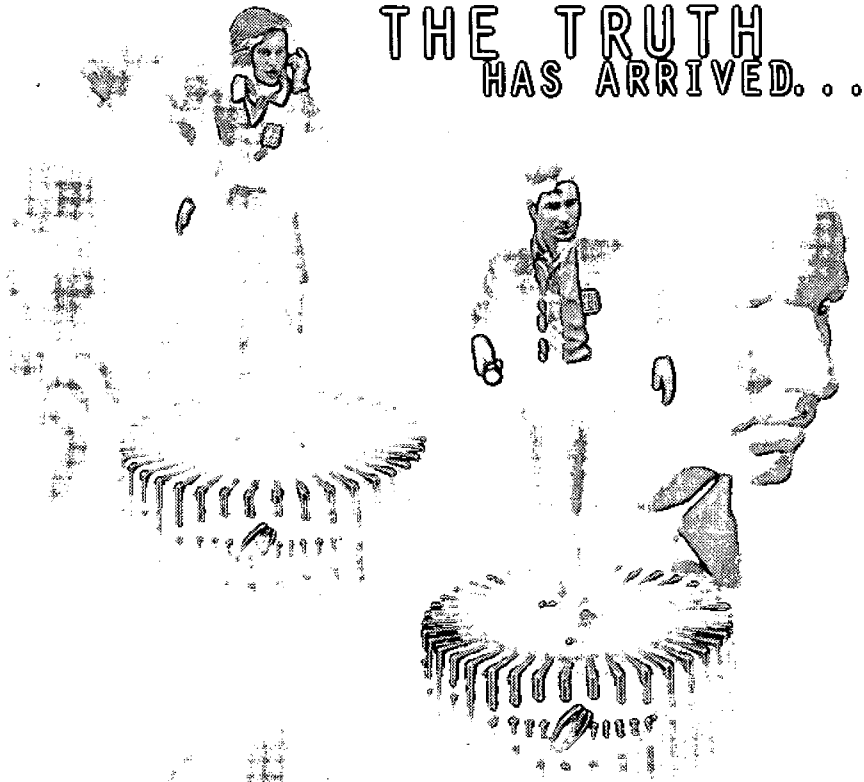

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EDITORIAL Stanley Schmidt

WHOSE LANGUAGE IS IT, ANYWAY?

One of the more interesting controversies to come to my attention recently—interesting because it is simultaneously amusing, frightening, and thought-provoking—concerns the content of dictionaries yet to come. Merriam-Webster, according to a Gannett newspaper story, recently assigned a task force to consider whether to change the order of listing definitions of a word in its dictionaries. This unprecedented move, we were told, is a response to complaints and a threat of boycott from a group that finds its first definition of a particular word offensive.

Merriam-Webster's practice up to now has been to list meanings in historical order, from oldest to newest. In the case in question, the oldest (and therefore first) has come to be generally regarded as an extremely offensive racial slur—which a paragraph on usage makes quite clear in the offending dictionary.

That's not enough to satisfy the offended and potentially boycotting group. They want the word's offensiveness to be the first thing mentioned about it, perhaps because they assume people who take the trouble to look it up won't take the slight additional trouble to read the listing all the way through (which, sadly, may often be true).

But even that is not enough to satisfy some of the dictonary's critics. The curator of a museum dedicated to the history of the offended ethnic group wanted Merriam-Webster to omit the word altogether. "If the word is not there," she was quoted as saying, "you can't use it."

Which is a perfectly charming theory, no matter how little it may have to with reality, or how easily its remoteness from reality can be demonstrated. The fact is that people very often do use words that aren't in dictionaries, or use them in ways that aren't in dictionaries. Therefore the quoted proposition is false.

Q.E.D.

But the whole issue remains of interest because of the way it raises two closely related questions. What is the function of a dictionary, if people can and do use words that aren't in it? And whose language is it, anyway?

That is why I brought this incident up in the first place, and why I haven't identified the word or groups specifically. (You can probably make some good guesses, even if you didn't see the news stories, but bear in mind that there are several words involved in similar controversies.) My concern here is not with whether or how any particular word is defined in a dictionary, or who can use it and when (if ever), but with the far more general question of how such decisions are made.

The "dictionary wars" are just one example of how some people think they *should* be made. Another occurred recently in *Analog*, when a letter writer in the April issue took me to task for writing, ". . . if a car owner would rather

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choose a different set of risks, why shouldn't they be able . . ." "When did the rules of grammar change?" the writer demanded indignantly, and I explained that the rules of grammar have been changing for as long as the language (*any* language) has existed. The changes are usually pretty slow, but the English of Chaucer is a long way from the English of today.

In the particular case of what pronoun to use for an antecedent of unknown or indeterminate gender, as I explained in my response to that letter, we seem to be in the midst of a significant change now. For many decades English used "he" for that purpose, but recently a sizable and vocal part of the population has decided to reject that usage. It can no longer be used without offending a good many people. That doesn't bother me in itself, but it's counterproductive as far as communication is concerned because it diverts their attention from the actual subject under discussion.

So a need has been widely felt for a tool that English doesn't have, and many writers and speakers have been casting about for something to fill the gap. Many somethings have been proposed, but so far none has gained general acceptance. I know of *no* way to phrase the sentence my reader found offensive that would not offend or annoy *somebody*. So I take turns offending or annoying different groups, and keep an eye on how large the groups appear to be—which gives me some feel for how the linguistic-evolutionary struggle is going.

When I wrote my reply to that letter, it was indeed the only one I had received complaining about that particular experiment with "they." Printing the letter and my reply, of course, brought out a few more saying they agreed with the complaint.

One of the most interesting and thought-provoking of those was from a reader in Finland who started out, "Please have mercy on us poor foreigners!" This reader quite correctly pointed out that English is already and increasingly the closest thing we have to a "universal language" for worldwide commerce, science, etc., and expressed concern that if such changes are allowed, "international" English will not be able to keep up and a gap will grow between the "universal language" and that actually spoken in America or Britain.

Well, maybe, though I must confess I can't get really worked up about that threat, if indeed it is a threat. With the explosive expansion of the Internet and other electronic communications, I don't think that English as *lingua franca* will have any great difficulty keeping up with changes that crop up in any of the places where it's spoken by residents among themselves.

Nor do I see any realistic hope of *avoiding* changes. This same reader wrote that, "For a language to be accepted as a universal language . . . It has

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to be totally unequivocal. There must be complete agreement on rules of grammar and spelling, and once these are established, they must not be changed." That, too, is a lovely ideal, but it isn't going to happen in the real world. I can sympathize with my reader, but my having mercy on foreigners won't make any difference. I'm not the one making the language change; I merely observe, report, and go along if and when it seems I must.

Language belongs to its users—not individually, but collectively. It exists only by consensus of its speakers, which is never unanimous or unchanging. Both of the controversies I've mentioned provide abundant empirical proof of that.

A dictionary is not a rule book; or rather, it is at most *partially* a rule book. There are two main things that a dictionary or grammar can do: (1) Describe the words and constructions that speakers and writers of the language actually use, whether or not the lexicographer or his or her readers approve of them. (2) Prescribe rules for what words, usages, or constructions are "acceptable."

What it cannot do is realistically expect, if it chooses to concentrate on Option (2), that real speakers and writers will always respect or follow its rules.

The most useful dictionaries, grammars, and classes, I think, must try to do some of *both* (1) and (2), while recognizing the inescapable truth of my caveat. A dictionary that makes any claim to being complete or comprehensive *must* include as many words as it can that are in actual use—even ones that are widely considered contemptible. It has to do that to be useful as a reference book. Even if everybody agrees that nobody should ever use a word again, a reader who encounters it in old writings needs to be able to look it up and understand what it was used to mean.

Doing that does not imply endorsement of every word listed as of equal value. That same dictionary can and should go beyond simply listing definitions, to include notes about what groups consider each usage acceptable or offensive under what circumstances. Similarly, a grammar can try to define a set of rules that "educated people" regard as things that should be followed—not because its authors represent Authority laying out What Must Be Done, but simply to codify a common currency that can be used and understood by everybody, despite regional and individual variations in casual usage. (It should also recognize

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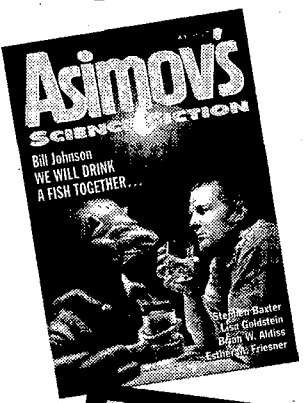

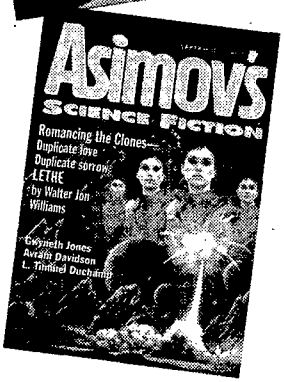

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that even educated people seldom use the same vocabularies or rules of grammar under all circumstances.) I myself have written articles* complaining about certain trends in "sloppy usage" (such as haphazard use of commas and hyphens) and advocating "improvements" (such as *careful* use of commas and hyphens).

But the people have the last word. A book that persists in promulgating rules that nobody (or nobody except English teachers) follows any more is of historical interest only; such rules have nothing to do with the language as it is actually used. If everybody decides to stop doing something and start doing something else, eventually the dictionaries, grammars, and classes will have to change accordingly. This has happened in recent decades, for example, with the acceptance of split infinitives and the title "Ms." I suspect that something similar is now happening with the search for a gender-indeterminate singular pronoun; it's too early to tell what the final outcome will be, but I'll be surprised if it's a reversion to the formerly generally accepted "he" with an implied "or she." There's too much uneasiness about that, and that uneasiness has been around too long, spread too widely, and gained too much momentum to fade easily away.

Some of the few readers who objected to my recognition of this and wanted me to go back to "he" (because it was an Old Rule) lambasted me for "caving in to Political Correctness." Sorry, not guilty. As I have made clear on many occasions, I have very little use for "PC." But this seems to have gone beyond that, or a passing fad (though it *could* just be an unusually long-lived fad; only time will tell). There is considerable evidence that in this case a significant part of our culture has identified a deficiency in its language, and is trying to find a way to fix it.

That is quite different from the aforementioned epidemic of sloppiness with punctuation. The "pronoun search" seems to be a case of the culture's more or less deliberately rejecting the old rule and trying to formulate a replacement. The sloppiness with commas and hyphens is simply sloppiness: people not bothering to learn the old rules or the reasons for applying them conscientiously, and teachers not insisting that they do so. There is no discernible new pattern there, but just a tendency for people to use or omit punctuation more or less at random. That weakens the language as a communicative tool, and some diligent effort to teach the rules, and the reasons for following them, could strengthen it.

Any living language is more or less constantly engaged in a tug-of-war between two forces. Changes in actual usage try to change the generally accepted shape of the language, and institutions like reference books and formal education try to keep the changes from getting out of hand. Both serve important purposes in keeping a language both widely useful and adaptable to changing needs. Both need to be understood, respected, and used wisely. ■

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* *See, for example, Writer's Digest, September 1998*

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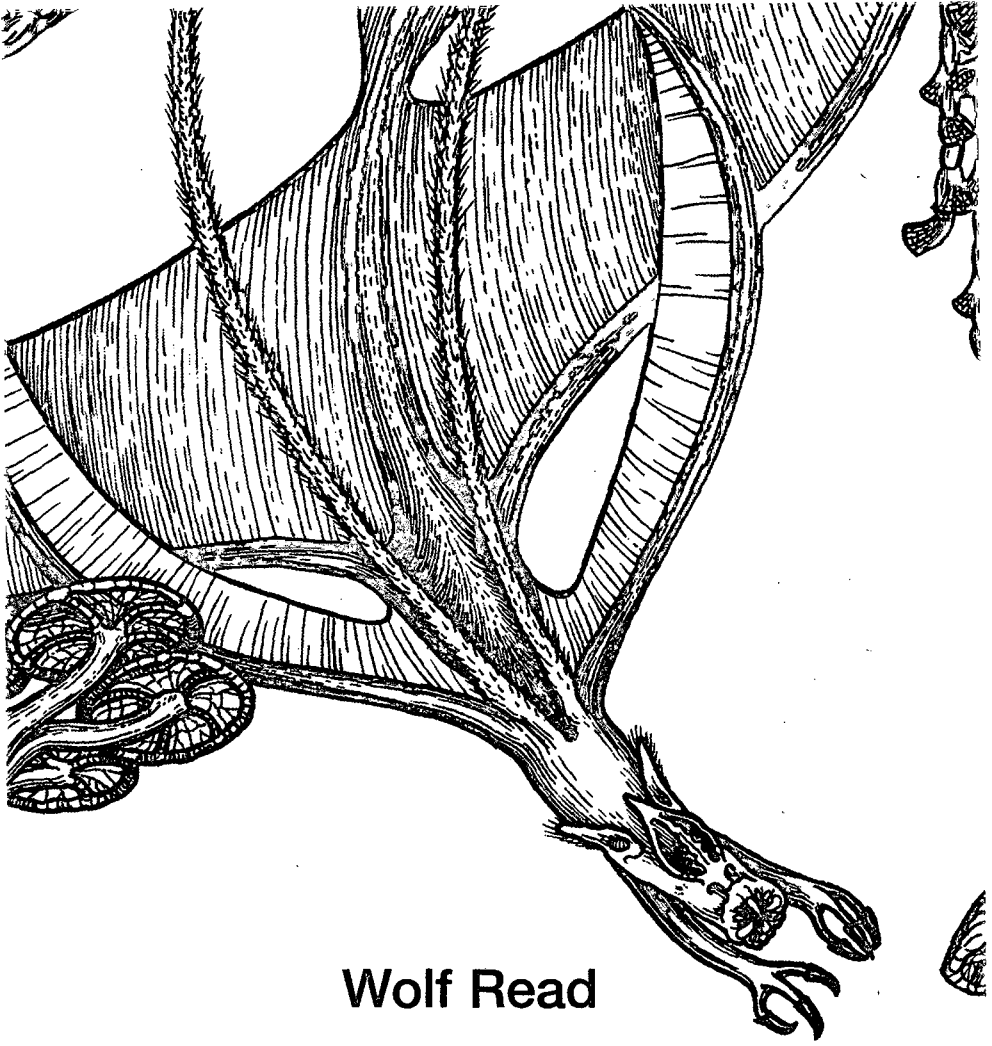

Wolf Read

DUEL FOR A DRACOWOLF

Protecting endangered species is always a controversial matter, but especially so when two other species—both intelligent but very different—are involved.

Illustration by Wolf Read

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Excerpt from the TELES Journal of Eponan Field Ecology, *Currents Column, Vol. 14, No. 3, January 16, 2265 (Earth):*

A suspected dracowolf was sighted by a hydrology field team last week. Witnessed by three members of the team, the large avian, with "at least a five-meter wingspan," was seen flying along the western end of Ascension Ridge, located in the southwest section of Tiene Eilean's equatorial Sere Valley. Due to a delay in the sighting's report, a quick satellite survey did not find a large avian in the area. Dracowolf expert Mirka Weathers-Selby, currently in the northern ranges of the island researching an earlier sighting, will probably investigate the new report in a few weeks. Until more evidence is gathered, the identification of the large avian as a dracowolf is to be considered unconfirmed, like all past sightings.

Leanna burst into Kieran's bedroom, breaking his concentration on the report. The wrinkled teal tunic and baggy trousers she wore hid well a small body that had yet to catch up to her fourteen-standard-year age. Between hurried breaths, she said, "Paskaal and Hegge are heading out to find that dracowolf sighted last week!"

With his index finger, Kieran tapped the old-fashioned digitizing pad and closed the screen. He wasn't surprised at the abrupt intrusion. Leanna was a bit impatient. "I thought that was an unconfirmed report."

She nodded as she pulled stringy brown hair from her sweaty face—she'd been running. "I guess they've decided to confirm this sighting."

Kieran leaned back casually, placing his long, forest green legs on his curved work desk—he still wore a field jumpsuit from an early morning excursion outside.

He understood Leanna's urgency. Her favorite topic was "dracowolves." Or at least what she insisted were dracowolves, like some of the more progressive biologists on Epona. She had sent him the report he'd been reading, for he shared her interest in Eponan biology, a common bond from which their long friendship had grown. "You don't want them to be the first to do so?"

She frowned and put her hands on her hips. "Not funny!"

"Sorry."

Leanna sighed and sat on Kieran's bed. "I think they want to answer the question once and for all—by killing the dracowolf and bringing it back here. I'm not sure. I didn't overhear everything. Paskaal almost caught me listening."

Now fully understanding Leanna's worry, Kieran dropped his feet to the ground and sat straight. "Isn't killing an unconfirmed dracowolf kind of stupid? If it is a dracowolf, it might be the last one."

She nodded, and added, "Nice thought. Maybe we can use that." She paused. "There may be more to their motivations than I overheard, and it worries me. Oh, hell, I don't care why they're doing it. Just the idea of killing a dracowolf makes me ill. We've got to stop them!"

Kieran considered an attempt to stop Hegge and Paskaal. He had been friends with the uther Hegge ever since the Deebee-ace flock agreed on occasional student "exchanges" to help understanding between the two people, a practice that had grown increasingly common over the hundred-and-ten years of uther-human contact. Kieran's relationship with the uther was not a close one however: there were times when the uther's ideas sent shivers down his spine.

Paskaal, who'd been at TELES as long as Kieran, concerned him even more than the uther. Paskaal was an intense person, with piercing dark eyes that enhanced a permanently serious face. Kieran had never felt close to him because

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the dangerous things he liked doing weren't appealing. Indeed, Kieran related to some of Epona's uthers better. Hunting a dracowolf was just the kind of thing Paskaal would be tempted to do if he had the opportunity, though he knew humans weren't supposed to interfere with Epona's ecology.

"Paskaal is stubborn," he said. "What do you propose doing?"

Looking strained, Leanna stood up, and paced the space between his bed and his closet doors a few times. She leaned against the wall next to the door, resting her back on a large flatscreen that showed an image of a Dyson sphere built by an imaginary pan-galactic culture. She said, "I'm not sure. I was hoping you could figure something out."

Images of Leanna being hurt in a conflict with Paskaal flashed through Kieran's mind, a disturbing scene aided by a fight between Paskaal and another classmate he'd witnessed last year. Paskaal's two-standard-year advantage in age had been generous with his stature and strength. Kieran wondered if he'd be just as strong when he reached seventeen, but didn't hold high hopes, for he was so skinny.

"We can't get any weapons," said Kieran. "I don't think there are any at this lab, and there's no way the replicators will make any for us."

Then what's Paskaal using on the hunt? he thought. *His fists?*

"Yes, but we've got to try to stop them, and we have to go now. They've already left."

Shocked, Kieran said, "There's a special field class on Tiene Eilean's ecology this afternoon!"

"We're going to have to miss it."

Kieran frowned at the idea. "I don't know—Teacher isn't very nice about such things. Those AIs can be quite cold. And you know what our parents will do. Remember what happened last time we skipped class?"

Leanna sighed and sat down in a chair next to Kieran. "We'll be tagged afterward."

Though, Kieran thought, *the punishment was worth it*. Sneaking past the Tiene Eilean Laboratory for Eponan Study's surveillance systems to get outside the treaty boundary was the best time he'd had in many months while living in the boring, eventless research facility. Admittedly, since the residents of TELES liked to maintain an "open lab" feel about the facility, the surveillance wasn't very sophisticated, a few tiny cameras here and there, offering only the slightest challenge. Though he understood the reasons for the treaty—backed by the metaflock leader, humans had legal protection in the unlikely event that an uther hurt a human—he couldn't understand why anyone bothered to keep tabs on the boundary. There were no restrictions on uthers crossing the artificial line: the Eponan Research Charter still applied within the TELES region, giving uthers free roaming rights. And the uthers didn't seem to mind people exploring their own territories unannounced. Uthers were always on the lookout for an opportunity to acquire technology. No better way than to befriend a human.

Still, the boundary was supposed to be respected, and being tagged got irritating after awhile.

"Do you want our parents to know our exact whereabouts again? We'll probably be wearing those embarrassing bracelets for months! There'll be no end to the jokes when we go to class."

Looking glum, Leanna said, "So we suffer a little. Think about what we get out of it! We could be the ones to confirm that dracowolves are still alive." Her appearance brightened as she said the words. "The long debates over what people are spotting, and the satellites are imaging, will end."

With her passion for the animal, Leanna had often talked to Kieran about those debates. The satellites showed

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avians that had many "dracowolfian" features, with one striking difference: They were only about half the size of the fossilized specimens that had been collected from the Sunken Continent long before the Tiene Eilean avians had been "discovered" by humans. Some taxonomists claimed that smaller size was enough to consider the newfound avians a separate species. The counter argument proposed by other biologists was that the living "dracowolves" were young and hadn't grown to full size. Or, some said, they were undernourished adults that were stunted—a good possibility on an island of limited size. If the avian being hunted by Hegge and Paskaal were found, the "dracowolf" could be watched, to see if it would grow the broad ten-meter wingspan seen in the fossil record. Or its young could be raised in a more nutritious setting to see if there was a size response—now that would be a challenge!

"Look," Kieran said, "I'm all for keeping one of these things alive, but at the expense of my freedom? Why don't we just tell someone what's going on?"

"And miss our opportunity to be the ones to confirm a dracowolf? If we find out exactly where it lives, we would have first dibs on its study. Might even get to skip some regular schooling for that task. Bring in the authorities, and no way. We wouldn't even get close—Mirka would get the study."

"You have a point." He tapped his fingers on his desk. He looked at Leanna, who was staring at him with a very serious look, and gazed into her brown eyes. Pretty were her eyes, and determined, a quality about her that he liked.

"But," he added, "uthers can do whatever they want on their own world. We'd be breaking the Eponan Research Charter if we tried to stop Hegge."

"Yes. But Paskaal's with Hegge. If we can convince Paskaal he's doing wrong—which he clearly is—then maybe Hegge will end the hunt with him."

"Sketchy, Leanna." *But a working plan,* he thought. The charter's rules were specific about not interfering with uthers, and, with Paskaal involved illegally in the hunt, they just might have the lever they needed to end the hunting trip.

"Face it, Kieran," she said. "If we want to find that dracowolf first, the only choice is to stop Hegge and Paskaal ourselves. We can always call the authorities if things get out of hand. And we may be able to get all this done before our class, if we hurry."

Why do I feel like I'm being dragged into this without any choice? The thought brought to mind a sad memory, one he had buried deep. A fallen cage, and a lost life, an Eponan avian pet he called Tripod, for its three-pronged tail. The memory left a nervous feeling in his gut.

Kieran flapped his wings, trying to keep up with Leanna. Somewhere, ahead by kilometers, the hunters flew. He scanned in vain for two tiny airborne objects, but only saw the stacked umbrella-like leaves of many lowland pagoda tree species. The primitive "plants"—more accurately called myophytes because of the osmotic myoskeleton that supported them—looked like a field of gigantic green, aqua and red mushrooms. Their broad paper-thin leaves rippled in the breeze like the roofs of giant tents. The circular leaves directly below Kieran seemed like giant wide-open eyes, with dark circuitous veins, and pupils marked by thick stem buds sitting in the leaves' middles. The pagodas gawked at him, unblinking.

Trying to see the hunters again, Kieran peered into the haze, squinting against the brilliant light of Taranis, a name given to 82 Eridani by the initial group of researchers to arrive at Epona. Autonomous robots were actually the first on the scene, but they deferred naming things to the people that fol-

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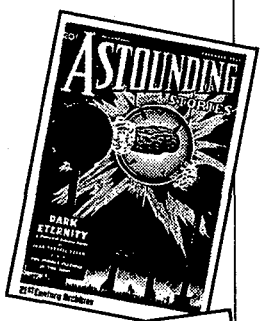

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lowed. Kieran felt pride in the fact that he was descended from one of the original survey team. His great-grandmother Maire McKenna had served as the ship's lead botanist. He hoped to fly on a beamrider to a new stars ystem one day, and spend his life learning about its worlds, just as she had.

Maybe on some faraway world he could find answers to a question that had nagged him for a while: with an abundance of life bearing planets charted during the century-and-a-half long era of stellar exploration, it seemed likely that there were far more intelligent species in the Galaxy than just human and uther. A fair number of these undiscovered sophonts had to be advanced in technology by millions of years. But no such grand cultures had been detected. Where were they? Surely humanity, with its expanding sphere of starships, was visible to these advanced species. Why hadn't they contacted anyone, human or uther?

To pass the time as they flew, Kieran said, "Hey, Leanna, do you ever wonder where they are?"

Leanna flapped next to him, supported by a pair of broad, composite wings that glittered prettily under the afternoon Taranislight. Her dark blue jumpsuit contrasted sharply against her clear wings and made her appear like a giant dragonfly. A digital 3-D recorder dangled from her belt, loaded with several petatrit holographic flash RAM crystals, ready to record anything that could be a dracowolf with billion-pixel resolution.

She gave him a funny look, and said, "Where *who* are?"

"The Elders." That's what he called the advanced species that had to be hiding among the stars.

Leanna rolled her eyes and said, "Oh, you're thinking about *them* again."

Kieran got that kind of reply often. "Well?"

"With a dracowolf's life possibly at stake," said Leanna while wearing a serious face, "I don't care where these Elders are right now—unless they're willing to help."

"That's just it," said Kieran between a wingbeat. "You think a species so advanced would want to help. Surely they'd have strong ethics. So why haven't they shown themselves to help us end things like war, and greed?"

With a mischievous grin, Leanna said, "Sometimes, Kieran, you're silly. There's no rule that says every intelligence has to have ethics."

"I disagree, Leanna. Once a culture has technology powerful enough to destroy things like planets and stars, it had better have the ethics not to do so, or one day it would end up destroying itself."

"Maybe." Leanna dove and glided ahead of him. She paddled the air hard, maintaining a fast pace.

Kieran followed, and felt an assuring surge of power as his wings firmly aided his strokes. Even with the wings' help, his arms were growing weary. He wished they could have taken an aircar, but that would have been far more noticeable than the much smaller powered muscle-augmenting wings they were using.

"If we keep this pace," he said, "we'll both tire before we catch Paskaal and Hegge."

"And if we don't hurry, we'll be too late," she said, with a degree of urgency.

Why's she so concerned? Is worrying about an uncertain dracowolf important enough to have sore arms tomorrow?

Kieran would have sighed if his breaths weren't so rushed. He flapped, maintaining a course toward a distant lump of foothills covered in a dense Eponan jungle—the location of the dracowolf sighting, and surely the spot that Paskaal and Hegge were heading to. Fortunately, the area was within the treaty boundary for TELES, which encompassed most of the Sere Valley, saving them from having to deal with the monitoring systems at the edge.

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How will Paskaal respond to quoted regulations? he thought, all too aware that they had little for defense. He felt the reassuring tug of the silver necklace that carried his microtransmitter, one he wore under his microweave jumpsuit so that no one could see it. Under normal circumstances, his cyberservant, "Ranger," tagged along on excursions outside and served as his communicator, but Ranger was too visible and had too much initiative to take on a trip of delicate nature. If things got ugly, Kieran would use the transmitter to alert the small but helpful TELES security team.

Leanna pointed at something on the ground and dropped down, fading under the canopy of circular pagoda leaves. Kieran followed, hoping they'd be on the ground and resting for awhile. His wingtips gently brushed room-sized leaves as he passed through the largest opening he could find.

Leanna stood in a thick patch of ankle-high upweed, looking like a giant among the forest of miniature pagodas. She held a glittery object with both hands. Her eight-meter-wide wings had folded up into a neat package on her back.

Kieran landed next to her. As he slipped his arms out of the straps so that his wings could retract, he disturbed a cluster of upweed. The small pagodas lifted their leaves like wind-upturned umbrellas: the simple osmotic muscle system that supported their stems offered a degree of mobility found in few Earth plants. Having played with the myophyte ability to move many times before, he paid little attention to the sudden motion, instead looking closely at the object in Leanna's hands: a sphere, made of some kind of coppery metal, with a strange rune on it. Uthers wrote by marking their different sounds on a musiclike staff, then following the points with lines: the rune looked like a seismometer graph.

She rolled the sphere on her palm, testing it. "Heavy. Do you know what it is?"

Kieran nodded. "That's an uther throwing sphere, an ancient weapon."

"Ah. It's so pretty. Hard to imagine it's a killing device." It dropped from her hands and landed with a deep thud. "I bet it's Hegge's. That writing is probably its flock's name."

"Let's find out." He picked up the sphere and immediately appreciated Leanna's comment about it being heavy. Grabbing his transmitter, he squeezed it and said, "Give me a reading on this writing." He pointed the small medallion's camera at the rune.

"Deebee-ace, Hegge. Slay quickly dracowolf," the little transmitter reported, after sending an image of the rune to the TELES database.

"I'm surprised Hegge would miss something that heavy falling from its tool net," Kieran said.

"Depends on how many the uther has, right?"

He nodded. "I think we should keep it."

Leanna crossed her arms. "And do what?"

"We need some kind of defense."

"How far can you throw that? Three meters at most?"

Kieran shrugged, but had to concede her point. Uthers were built differently. With a limited hydrogen peroxide "muscle boost" to aid already strong extensile muscles, an uther could toss the sphere much further than a human. In Kieran's hands, the throwing sphere was an ineffective weapon at best.

"Most likely, Hegge would just take it from you."

"Still—"

Looking disgruntled, Leanna said, "We don't want to help Hegge kill a possible dracowolf. Put it down."

He hesitated.

Leanna gave him a look that was both determined and pleading.

"Oh, all right," he said. A bit irritated, he tossed the object toward the decay-

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ing stem of a fallen pagoda tree. The metallic sphere flashed and hit the sagging trunk with a loud, unmistakable crunch. Like a dropping tear, it rolled down the side and sank below a cluster of stubby handlike Y-stem.

Leanna ran to the fallen pagoda and exclaimed, "Oh, no! You smushed a pet rock!" She looked sad, holding her lower lip out, an expression she used every time she heard about something dying.

Feeling guilty, he dashed over and stared at the broken armor of the tiny ceretridontid. *If I'd just looked before I threw*, he thought, feeling angry at himself.

A second pet rock walked past the remains of its dead companion, its four beady eyes staring coldly from behind its rough cranial armor. Pet rocks were one of many myoskeletal pentapod creatures known as ceretridons, ground-dwelling cousins of the avian group that included uthers. The extensile muscles of the pentapod myoskeleton served a dual purpose, acting as the creature's support structure while also providing the mechanical action for movement, making for highly flexible creatures. Most ceretridons walked on three legs, unlike the quadrupedal pet rock, with a few moving about on two or one.

The little pet rock found a beetlelike silacopod and pounced on it, looking like a flying, four-limbed chunk of vesicular basalt. Holding the flailing silacopod with a three-fingered tail, the pet rock broke through the pseudo-beetle's glassy exoskeleton with the crunch of strong chitinous teeth at the end of its long head. The pet rock didn't pay attention to its squashed relative—indeed, it even whacked its meal hard against the cracked shell, unceremoniously shoving the corpse from the pagoda trunk. The dead pet rock landed next to the polished sphere that had killed it.

How can this pet rock accept its dead companion so easily? Kieran asked himself. The question made him remember Tripod. He couldn't have predicted the weather that day. The situation had been beyond his control, the product of a powerful wind gust washing through his window, knocking the cage over, a disruption to Tripod's world that had . . . He shoved the thought from his mind, wondering why the disturbing memory was surfacing now.

The pet rock continued to eat, making a mess of its face as it dug into the silacopod's shell. Kieran felt like slapping the indifferent creature away.

"They're cute," said Leanna as she elbowed her wingpack, "but I don't need to see one eating." Leanna walked away as her wings expanded. After securing her arms, she spread her airfoils wide and flapped hard, slowly lifting above the enclosing pagoda trees.

Despite Leanna's insistence that he leave the sphere behind, he grabbed it, feeling strongly compelled to keep it. The sphere was a lucky find in an uncertain situation, and he just couldn't pass it up.

He also was not convinced that Hegge would miss something so important falling from his tool net. He wondered if Hegge left it behind deliberately, a question that could only be answered by the uther. After commanding his wings to ready themselves, he dropped the metal ball in his pouch, strapped his arms to the foils, and leaped from the ground with a powerful flap. The wings solidly gripped Epona's atmosphere and carried him up.

He saw Leanna delineated by the tiny V-shape her wings made, her navy blue jumpsuit hazed by the moist atmosphere. She had gained a considerable lead. He steadily increased his pace to catch up, feeling the weight of the throwing sphere at his side.

"I think I see them!" said Leanna. "They're right at the base of the hill, standing on the riverbank." After setting her wings into a slow glide, she grabbed

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her camera and recorded some footage of the two figures, using the aid of a gyroscopically correcting ultrazoom lens from her unstable vantage.

Kieran looked in the direction she indicated.

Ascension Ridge, their destination, had become large and imposing as they neared. A broad river flowed along its base, its swirling waters surging past shallow exposures of ancient sedimentary rocks deposited in an era before humanity, maybe even before the most recent of Epona's cyclic one-hundred-million-year-long ice ages. Many ragged pagoda trees along the banks leaned over the river. Some had fallen, their hollow trunks making turbulent eddies in the flowing water. The oldest logs were flat topped, their osmotic cells having dried under Taranis's intense tropical light, reducing hydraulic pressure and causing the exposed part of the trunks to sag.

Kieran spotted the tiny figure of Paskaal standing next to one of the fallen trees. The red trim of his gray jumpsuit showed clearly against a ground cover of turquoise pagodas.

The uther Hegge "stood" nearby, propped up on the three leg-sized "fingers" that supported its broad hind wing. The uther's myoskeleton offered certain benefits, one of which was the ability to use flexible wing spars as rudimentary legs. Hegge carried its two forewings neatly draped along the back of its narrow, cylindrical body. With the skirtlike hind fluke supporting it, Hegge looked like a figure wearing a "cloak" mottled in muddy greens and browns.

Kieran felt a nervous twinge in his gut as he stared at the two hunters. Paskaal was a determined fellow, and Leanna likewise. He could only see trouble.

"Do you think we should bother them?" he asked, hopeful that he could persuade Leanna to leave. "What are their chances of finding the avian, anyway? Sightings have been so few, and no search has turned up an actual dracowolf."

Leanna gave him a measured look. "I'm not willing to take that chance. The possibility of finding a living dracowolf is too important to risk letting someone kill it." She hooked the camera onto her belt. "Remember, the Deebee-ace uthers insist that the there *are* dracowolves living here, despite the difference in size between the Sunken Continent fossils and the avians imaged by satellite. Maybe it's time we listened to the uthers."

Kieran nodded. "But is a dracowolf more important than your own safety? Paskaal isn't the nicest guy around."

"I'm willing to take a chance on that." Leanna, holding her lips tight, swooped away, and, with her wings fully extended, floated down a few meters from Paskaal and Hegge.

Feeling helpless, Kieran followed her lead, hearing the soft crunch of bubbleweed under his feet as he touched ground. Gratefully, he pulled his arms out of the wingstraps. As the wings folded up into a manageable size on his back, he rubbed his sore muscles. Hot moist air sent his body into a furious sweat.

The uther moved its elongated head—a joint in the collagenized muscle that housed its head and body served as a neck. Hegge glanced at him with one of its sideways-facing eyes. *Is Hegge looking at my pouch?*

Paskaal studied Kieran and Leanna with dark brown eyes that nearly matched the color of his skin. He rubbed sweat from his short, curly hair, and said with a deep voice that matched his size, "What brings you here?"

Kieran was too nervous to speak.

Leanna took a step towards him, water dripping from her face. "I had the same question for you."

He smirked. "That's none of your business."

"I make it my business when there could be a dracowolf involved."

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He didn't look surprised. Just cold, indifferent. "I thought that was you who ran down the hall."

"Maybe you should change those plans."

"In a way, with you and your friend here, that may have already happened. But we're still going after that dra—avian."

Leanna paused and lifted her eyebrows. With slow, careful words she said, "Article Ten of the Eponan Research Charter. No endangered species may be killed for any reason."

Paskaal frowned and walked a few paces closer to Leanna. Leanna's small frame looked even more diminutive next to his. "You know as well as I," said Paskaal, "that dracowolves are extinct. The avian we're hunting is not endangered."

"Don't give me that! The uthers insist there are dracowolves here. And considering how few sightings there've been of any large avians, they must be rare. Probably endangered. You can't hunt them regardless of their identity."

A series of whistles drew everyone's attention to Hegge. The melodic language was roughly translated for Kieran by a device in his ear. "My flock's way dracowolf hunting is. Not bound by silly charter are uthers. Paskaal, though human may he be, is partner I have chosen for this task." Pentapod respiration went one way: in through the mouth, down a body wide network of alveoli, and out pores in the skin. With speech produced by the simple constriction of the primary windsack muscles on the inflowing air, uthers had the remarkable ability to talk continually without having to pause to take a breath.

Leanna, to her credit, was not deterred by the uther's words. "But don't you care that the dracowolves are almost gone? We know almost nothing about the creatures. You'd destroy the opportunity to learn?"

The uther's flexible skeleton made it seem uncannily relaxed even in its upright state. It twitched the triangular sonar organ at the top of its head. Another melody erupted from Hegge that Kieran's implanted translator awkwardly reported, "Learn? Our legends about dracowolves humans record, but take seriously humans do not. Dead dracowolf we show humans once, but people mention that too small the beast is, not like rock impressions from the Sunken Continent where the first metaflocks were contacted. A place where no longer do uthers hunt dracowolves—but beast is still strongly in legend and tradition. Strange are humans. Identity of things far too important to them. Too picky they are about appearance of the dracowolves. Realize they do not that much about dracowolves uthers know. Listen to us more, humans need to do."

"Still," said Leanna, "you might have missed something."

"True that might be. And important. Since utherkind's beginning, in conflict dracowolves and uthers have been. Gifts to join long ago flocks dracowolves were offered. Not work did this. Untamable will dracowolf is, and much past trouble has it caused. Learn we do about dracowolves as we make them fall from the sky. Knowledge valuable, for win fights it helps us do. Battle we must until one or the other is gone."

Leanna gasped and said, "That's senseless! Things are different now. You can leave Epona and visit other worlds—you don't need to carry on such battles. At worst, the dracowolf is just a small problem."

Leanna's breaking the charter and interfering with the uther! Kieran opened his mouth to speak.

Hegge spoke first, its rapid notes echoing from the surrounding terrain. "Leanna, choice there is not." Irritated, Hegge waved the two extensile arms positioned at either side of its head like thick ropes, holding its three fingers balled. "Battle dracowolf my flock chose me to do, and complete the task I must."

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"But there must be a choice!" Kieran cried out, moved beyond his fear by Hegge's words and his memory of Tripod. "You can simply refuse to hunt a dracowolf."

"And learn not? Look bad in my flock's eyes, I will then, as task is assumed by someone else. Gain knowledge uthers must." Without a pause, Hegge hooted loudly, sounding like a barking dog, an indication of laughter. The deep hoots transformed into speech. "Amuse me do you humans, with insane ideas that difference in the way things are meant to be can be made."

Kieran froze. *What is it implying?*

"Well," commented Leanna, sounding a little less sure, "I plan on making a difference." She walked next to Kieran and said, "Call the authorities, Kieran. Let's stop this right now."

Kieran hesitated, and thought, *Is Paskaal still bound by the Eponan Research Charter when Hegge gave him permission to break the rules?* He didn't know.

"Yes," said Hegge. It dragged the right tip of its broad hind wing forward in the best uther walk, then stood straighter, stretching its wingmuscles as far as they could go, making Hegge look much taller: the uther probably learned the intimidating stance from watching humans. "Authorities you call, and in trouble will you be. Ways of my kind you are interfering in. Banished from Epona you could be."

Leanna stared at the uther, appearing strained.

Hegge relaxed, slowly shrinking like a wilting plant. "Right, conditions are, for the dracowolf's death. Establishing they have been since before its discovery. More blind than a dracowolf you seem. Sense that you will fail you are unable." The uther extended a tentacle-like arm downward, and produced a vicious-looking weapon from under one of its forewings. Kieran recognized the diamond-shaped point, long shaft and brightly polished hand guard as an utheran push spear.

Leanna gasped and took a step back. "Y-you-you aren't—"

Kieran slowly reached for his pouch.

Hegge spread its forewings wide, making it appear like an angel from old Earth legends. With a flap powerful enough to shake nearby pagoda trees, Hegge darted high into the air, carrying the push spear forward, next to its head. His broad wings quickly faded as he raced uphill.

Paskaal laughed as he saw Leanna's look of relief. "We aren't crazy." He extended his mechanical wings and followed the uther.

"I will stop you!" she screamed into the sky. "What you're doing isn't right!" She dropped to her knees, her face red with anger.

Kneeling next to her, Kieran said, "Leanna, there's no need to be so angry."

"Kieran," she said as she stared at the ground, "I know where your Elders are. They're laughing at us because we're still so primitive that some of us would kill a dracowolf just for fun! Paskaal and Hegge probably bumped us down the first contact waiting list by several millennia."

Kieran nodded, but felt in no mood to discuss the Elders. "There's probably no dracowolf," he said, trying to assure her. "One has never been found after any sighting."

She looked into his eyes, wearing a sharp expression. "Paskaal and Hegge were so confident. And back at TELES, Paskaal commented to Hegge about the avian sightings being accurate. . . . We've *got* to stop them!"

Confused by her certainty, and the unexpected information, he simply stared at her.

Leanna stood up. Like an insistent gust of wind, she flapped uphill, toward the distant forms of Hegge and Paskaal.

Kieran watched her fade into the haze. He vividly recalled Hegge's words about there being no choice. Was Hegge

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right? He felt the throwing sphere tugging at his belt, and remembered the pet rock he'd crushed. Had the sphere already been thrown toward the dracowolf, even before he and Leanna heard of the sighting? Maybe a million years ago, perhaps, when the first uther died to the sharp claws of the largest avian to fly Epona's skies.

A thrown sphere was beyond anyone's control, and it didn't care who it landed on.

"Leanna, stop!"

With a nudge of his elbow he urged his wings to extend, and he quickly slipped his arms into the straps. Pushing with all his strength, he soared after Leanna.

Kieran flapped hard, his breaths erupting from his lungs as he strained to catch up to Leanna.

Leanna was still quite a distance ahead when he saw the tiny dot representing Hegge drop straight down into the pagoda jungle, just in front of a stand of ancient cathedraltrees that stood high above the regular canopy. Cathedraltrees were among the largest of pagodas, adding one olive-green mushroom-shaped tier on top of another over many years, often reaching a hundred meters in height. Their longevity made them the home of many Eponan creatures. Kieran had spent much time with Leanna finding insect-like silacopods, parasitic and epiphytic pagodas, endoskeletal snapping flowers, avians, and small arboreal ceretridons in a cluster of cathedraltrees near TELES.

As Kieran studied the giant pagodas, Paskaal banked, following Hegge's lead, and faded behind the circular leaves. Leanna paused after Hegge had disappeared, content with a steady glide toward the cathedraltrees. She grabbed her camera.

Why'd Hegge dive so quickly? Is it trying to lose us, or did it see something that frightened it? Whatever the reason, the action left a nervous feeling inside his gut. He hoped Leanna wouldn't do something rash.

Leanna placed the camera on her belt. She pumped straight for the tallest cathedraltree, a wind-shredded, lightning-scarred specimen that was easily twice the age of the first human-uther contact. Kieran saw something massive resting in the giant tree's thick foliage.

The dracowolf? "Leanna, wait!" He found the strength to fly faster.

She ignored his plea and dove right at the emergent stand of pagodas, yelling down at the spot where Hegge and Paskaal had hidden, "You won't get this one so easily!" Deliberately colliding with one of the cathedraltree's abused leaves, she sent a vibration through the whole tree, one that jittered some of its close companions. After a brief loss of control, she forced her wings to catch air, and banked down into the foliage.

Kieran heard a deep thud and felt the sound throb through his body like a powerful heartbeat. A number of avian species burst from the pagodas below and skimmed down the hillside, miniature uthers frantically racing away. The giant avian had just emitted a strong and deep sonic pulse—a territorial signal that some avians used.

He dove for the cover of a cluster of dichotomously branched neopagodas, and sank low into waist-deep Y-stem. As his wings folded up, he stared towards the giant cathedraltree through the semitransparent leaves overhead.

The cathedraltree shook violently. He saw two broad forewings unfurl, so big they appeared more from a machine than an animal. He gasped. *Five-meter spread*, he thought, *maybe more*. The dracowolf—Kieran had no doubts now—flapped once, a pulse that tore shreds from the leaf it rested on, sending fragments flipping crazily though the air. Its long body lifted, and the beast cleared the highest tier of the tree. The dracowolf's hind fluke made its forewings look small. Kieran felt as if a

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heavy weight was delicately suspended above him.

Trailing two long sensory filaments behind like a titanic kite, the beast dove straight toward him.

Kieran dropped into the Y-stem as the dracowolf skimmed the tops of the trees. Expecting pain, he cringed as he crouched in the weeds. He heard the dracowolf's tremendous wake send the pagodas into a violent sway, snapping their tops. One top crashed heavily on to him, knocking out his breath.

Pushing up on the leaf that had just blanketed him, Kieran looked through its thin, semitransparent material. He saw the dracowolf climb high and fade into a small cumulus cloud accented pink from the setting sun.

He heard something crashing though the undergrowth uphill from him, turned, and saw Paskaal leaping over squat globe pagodas and fingery Y-stem. "You fools!" snarled Paskaal as he yanked the heavy pagoda leaf off of Kieran. "Awaking that dracowolf was seriously stupid! Your girlfriend is going to get us killed." There was rage in his eyes, not wild—but cold, calm.

Kieran coughed and said, "S-she's not—" and stopped himself. *Isn't she?* He couldn't place exactly when his feelings for her had grown beyond friendship during their long camaraderie. But the emotion was there, deep inside: a caring that had certainly brought him into this frightening situation.

Paskaal grabbed Kieran by his folded wings and yanked him up with a thick, muscular arm.

Fearing for his well-being, Kieran said out of habit, "Ranger, call—" before he remembered that the cyberservant was not with him. He reached for his communicator.

With a surprisingly fast motion, Paskaal lifted the device from Kieran's neck. "Not yet, Kieran." Paskaal placed the communicator around his own neck. "You're going to help, not hinder."

Kieran heard a hooting to his left. Hegge descended from a pagoda and landed next to them. "Paskaal, realize do you not. In motion things have been for long time now, and playing her part Leanna is. Fool am I for not seeing the indications. Account for you humans more with each passing year we uthers need to do, if your technology we keep."

Paskaal glared at the uther and replied, "I don't know what you mean, you crazy overgrown bat, and I don't really care. But we had better find Leanna before she does something else stupid."

Kieran nodded, amazed that there was something he and Paskaal could agree on.

The uther hooted again, very loudly. "Nothing can you do now, Paskaal. Revel in the joy of the hunt, and the joy of being hunted."

Again Hegge managed to say something that left Kieran wondering, and again the image of Tripod's falling cage, swept by that long ago thundergust, came to mind. He looked at the uther. "What do you mean?" he asked in an almost desperate voice.

"More important than all the others, this hunt may be. Battles between uther and dracowolf may end finally. Who survives hunt, it will depend on. Which way that will go, know I do not. First time this is, and discern I can not any patterns to understand how things will be."

"I still don't understand."

"Instructor, I am not. Design of Nature determines what you learn."

Considering Tripod's unexpected death, Leanna's urging him to join her on a chase that entailed trying to change the minds of two sentient beings, and the impossible-to-foresee crushed pet rock, he thought, *Many things seem to be by Nature's design*. And with that, he realized that just maybe he and the uther shared a perception about the world.

With determined speed, Paskaal led them up the hill toward the spot

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where Leanna had landed. He hacked through the springy undergrowth with a shiny short sword. Kieran had some ideas where Paskaal procured the weapon, all pointing toward Hegge. The uther had probably offered it as a "bribe" to convince Paskaal to join his hunting "flock." That same uther materialism gave humans the opportunity to trade limited technology for visiting rights on Epona. The TELES treaty boundary was one such deal, involving a gift of prosthetic devices for crippled uthers in the local metaflock. With the uther's endless desire to acquire more wealth, the prosthetic devices had been traded around, and were now showing up all over the island of Tiene Eilean.

The jungle grew dark as numerous leaves from tall emergent pagodas covered setting Taranis. The undergrowth thinned to a few, sometimes bothersome, stringy Y-stem. Some of the stems Paskaal cut writhed on the ground before being stopped by the drain of fluids from their osmotic cells. Kieran couldn't help feeling that they were animals, and often chose to look away.

Broken, spongy bubbleweed covered the ground, muting their footsteps. Kieran wondered if a herd of large pagodivorous ceretridons had run through, crushing the bubble leaves. Scanning for footprints, he found the telltale broad impressions of monopedal twintails faintly pressed into the soft ground—a lanky beast that often reached four meters tall at the point where the leg joined the body. They were probably frightened away by the dracowolf when it had awakened. He wondered if a dracowolf would prey on animals as large as twintails. Probably not. Maybe young were present. He looked around, trying to see the always elusive ceretridons, but saw no hint that the there were any nearby.

A sickening stench caused him to hold his nose.

"Dracowolf waste," said Hegge, who obviously had caught the odor. The uther twitched oval ears sitting behind its large eyes, changing their ellipticity—it was listening for something. "Under the dracowolf nest we are."

Kieran looked down and saw various rotting avian parts sitting among piles of grayish stuff whose origin he didn't want to contemplate.

Paskaal stepped carefully around a large pile and glanced back at Hegge, "It has been some time since we've seen the dracowolf. Looks like it ran away to me."

"No." Deftly waddling on its hind wing, the uther circumvented another putrid obstacle. "Recent sonar sweeps I have felt. Beast is distant, sonar feeling weak. Since awaking, studying us dracowolf has been." After a brief pause, the uther said, "Signaling also, the beast has been, indicating nearby others may be."

Kieran nodded, recalling the many times Leanna had described the territorial calls used by many predatory avian species. The pulses were too deep to be useful as sonar, and were probably created in the same manner as an uther speaks: by using the primary windsack, freeing the sonar organ for its echolocation function during times of communication.

"Well, then," said Paskaal with a hopeful tone, "maybe it'll find something palatable about its cousins, and forget about us. Then we can either leave, or attack it after it has become satiated."

"Paskaal, thinking wishful you are. Avoiding each other, are dracowolves good at. In region many large pagodivorous avians I have seen, easy prey similar to these." The uther indicated all the remains with its uncannily flexible arms, its three fingers spread wide for emphasis. "Be back, the dracowolf will be. Me it is more interested in, probably, than you. Odd enough might you be, that ignore you it may."

"I'm not about to count on that."

"Suggest you do, not I."

Picking their way around the un-

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desirables, they succeeded in crossing the top of the hill. Paskaal continued hacking the Y-stem out of the way, while Kieran vainly tried spotting Leanna in the reddening evening light. In the distance, he heard a distinct series of hoots, probably a ceretridon speaking to others of its kind, the first animal noise he had heard since the dracowolf had been awakened by Leanna. As the ceretridon quieted, several piercing chirps sounded from a nearby pagoda tree as a spiderlike silacopod called for a mate. Silacopods had two sexes, he recalled, unlike the single-sexed pentapods.

With the growing animal sounds, things certainly seemed to be returning to normal. He wondered if Paskaal might be correct about the dracowolf running away.

Feeling a bit calmer, Kieran let his mind wander. He wondered what an Elder might do in his predicament. Probably use some kind of magical technological device that would lure the dracowolf safely away. Even better: an Elder could probably fly at such a high speed that the avian wouldn't be able to catch him. Hell, an Elder was someone smart enough not to let a dracowolf become a problem!

But, again, where were the Elders? Maybe Leanna's comment about being bumped down the first contact list was right. Hunting a dracowolf did seem backwards. Was it possible that each individual within a culture counted towards determining contact desirability? Certainly the Elders had the technical capability of keeping tabs on many things, if they so desired. Until a civilization got its act together and accounted for everybody, it was probably considered too primitive. He wondered if keeping a pet locked in a cage, like he had Tripod, was also deemed a primitive act. He frowned.

"Throwing sphere you carry, Kieran?" came the uther's melodic speech.

Shocked by the sudden question, he looked at Hegge nervously.

"Throwing sphere let me see." The uther held out its three-fingered hand.

Resigning himself to losing the weapon like he had the communicator, he handed over the ball of metal.

Hegge hooted quietly. "Throwing sphere is mine." The uther eyed Kieran. "Find throwing sphere, how did you?"

"A . . . Leanna did. She spotted it from the air. Luck, I guess."

"Not luck. Not real, luck. Meant to have throwing sphere, obviously you were. Throwing sphere you keep." The uther handed it back to Kieran.

Holding the sphere in his palm and staring at it questioningly, he asked, "Why did you leave it behind?"

"Before actual hunt, throwing spheres I place strategically around hunting region. Too heavy to carry all."

Kieran nodded and dropped the glittering weapon in his pouch, feeling strange at the turn of events. Paskaal stared at him, obviously unhappy with the uther's decision to let Kieran keep the sphere.

Feeling more comfortable with the uther, Kieran asked, "Hegge, I know the tradition is important to your people, but I wonder why this hunt is so important to *you*?"

Hegge paused a moment and stared at Kieran with one eye. "From the sky, new knowledge falls, sometimes as bright flare, sometimes as other objects, such as dracowolves. New knowledge on ground uthers can obtain—but quickly, before knowledge fades into the world beneath ground, or is carried back to the sky."

Kieran asked, "What knowledge?"

"Whatever knowledge the sky drops. Learn much utherkind did when human spaceships landed. Similarly, learn I do by killing dracowolf, and to the ground it falls."

Kieran nodded, trying to imagine how the uther's religion could have begun. Hunting was a constant learning process, and uthers acquired most of their prey from the air. In that situation,

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it might seem to uthers that knowledge was gained from the fall of their food from the sky. With such a belief system, he could see why some uther flocks had been strongly moved to acquire human spacecraft and space stations. Human space technology represented much knowledge, and uthers were keen on learning from things in the sky, as was discovered during the "Fugue" incident over a decade ago.

With those ideas, Kieran realized that both Hegge and Leanna were after the same thing: to learn about the dracowolf. The conflict between them was simply about methodology.

Walking behind Hegge, Kieran stepped around a cathedraltree. He heard a gasp and stopped. He looked in the direction the familiar sound came from, and studied an ancient, rotting pagoda "log" that had sprouted new, green trunks along its length. He asked, "Leanna, is that you?"

Leanna poked her head from a fenestration in the collapsed trunk—her hair a chaos of frazzled strands from her long flight. She frowned. "Kieran, what are you doing with *them*?"

Kieran hesitated, looking from Paskaal to Hegge as he considered his answer. "They've sort of drafted me since you awakened the—"

"What was with that stunt of yours?" interrupted Paskaal, the look of cold rage returning to his face. "We could've been killed."

She crossed her arms. "As you would a dracowolf."

"That's beside—"

A loud thump cut him off, a chest-felt noise that arrived from all directions at once.

Hegge said, "In the pagoda trunk!" The uther dove in next to Leanna. Kieran followed. Paskaal stepped in behind them, ducking his head to avoid the log's sagging ceiling.

Leanna stepped a few paces back from the hunters, giving them the evil eye. Kieran moved next to her. She looked at him, her face no more comforting. "How could you be with them?"

"I had no choice," he said, feeling guilty. "And they offered to help me find you."

She looked away, holding her arms tightly crossed, but her face had lost its edge.

Paskaal glanced at Leanna. "Not that we had any more interest than to keep you from worsening things." With a twist of his head he indicated the dracowolf outside. "We're in this together now."

Leanna frowned at Paskaal and sat down—not too far from Kieran. Kieran felt a little better, and sat down next to her.

"There!" said Hegge, who watched out of an oval fenestration in the trunk. "Flying overhead the dracowolf is. Near is our time."

"What's our plan?" asked Paskaal. "Things have always been much easier than this."

Kieran looked at Paskaal, wondering what he meant.

Before Kieran could voice his concern, Hegge dropped his head from the window and glanced at Paskaal. "A difficult matter making a new plan, since failed our first method." Hegge gave Leanna a single-eyed stare, but Kieran could perceive no expression on the uther's long face. "Many easy hunts have price, maybe." The uther paused.

Kieran noticed Leanna watching Hegge intently, as if she were contemplating the uther's words.

"Idea I do have," continued Hegge, "our greater number making an advantage. Best flyer I am, so to the air I take as bait. Draw the dracowolf toward you hopefully I can, Paskaal. Attack it from behind, you then can. Blind the beast is, and focus of sonar will be on me."

Kieran felt a surge of fear for Hegge. He realized that somewhere in their brief encounter he had developed some caring for the uther. "That push spear looks

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quite small compared to that dracowolf. You could be killed."

"Such is my fate then, like many dracowolf hunters' fate in the past. Accept fate I had to, before a hunter I could become. Useless worrying about, it is."

Leanna, looking very unhappy, said, "I don't like your plan. Maybe you can think of something that doesn't kill the dracowolf."

Hegge abruptly waddled up to Leanna and stared closely at her with a sideways eye. "That choice we do not have. Helping the dracowolf you thought when awaken it you did, but help dracowolf you did not."

Kieran didn't want to hear another argument. He said, "Isn't there room for compromise?"

Leanna and Hegge looked at him.

"You both want to learn about the dracowolf. The problem is how each of you go about learning." Kieran looked at Hegge. "Maybe you can spare the dracowolf for awhile, giving Leanna a chance to study it."

Hegge hooted. "Assuming you are, that let us live dracowolf will do. Run away we cannot, for catch us dracowolf will do. Subdue dracowolf we cannot, for out-endure us dracowolf will do. Survive how, if kill it we don't?"

Kieran blinked at the obvious information. "There is a way." He glanced at the communicator around Paskaal's neck, hoping Hegge would be reasonable.

"Kieran, Leanna, no. Room for compromise there is not this time." Hegge looked out the window, and appeared to go into a reflective state. "A manifestation you humans are of this situation that was bound to happen since first contact. Until it concludes play it out we must. Among the last dracowolf hunts ever this may be, and whether or not it will be Nature decides."

Is there a sense of disappointment to Hegge's words? thought Kieran.

Leanna, unperturbed, said, "Yes, this *will* be the last dracowolf hunt. When I inform my parents that you uthers have been using the avian encounter reports from the newsfeeds to aid in your pursuit of killing them, those leads will be cut off to you people, maybe forever."

Kieran gasped as he finally realized the gravity of the situation.

"Assumption you make still, getting off mountain alive. Not yours, Leanna, that choice. If die dracowolf does not, that our fate will be."

"I don't need to get off this mountain." She turned to Paskaal and held out her hand. "Give me that communicator!"

Paskaal hesitated, glancing outside and looking for the dracowolf, obviously unsure about what to do.

Hegge sang in a steady tone, "Time is wasted in contacting authorities. To get here, authorities take too long. Dracowolf will attack sooner."

Leanna continued staring at Paskaal. "Maybe not."

"Interfering with a tradition of my people, you are, Leanna. If authorities find out, banished from this world forever you will be."

"But I'd still be alive. And your hunts would get harder." Leanna ducked under a low spot in the log's ceiling and stepped closer to Paskaal. She stared him in the eye. "You don't want to die, Paskaal. I can see it."

Moving his hand slowly, he reached for the communications medallion sitting on his chest.

"Paskaal," countered Hegge, "banishment from Epona you face also. Hunting rare species is disliked. Stuck in isolated space station you will be, if authorities she speaks to."

Leanna yanked the camera from her belt and tossed it at Paskaal's face with surprising accuracy. With a quick swing of his arm, he blocked the unexpected missile and sent it spinning toward Kieran. Kieran ducked, falling onto his side. The camera bounced off the wall and landed next to him. Leanna jabbed her leg under Paskaal's swinging arm and awkwardly kicked his left knee. The glancing blow made Paskaal cringe and

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nearly fall. She reached for the medallion and grabbed it.

Paskaal shoved her away with a single strong arm. She flew backwards, gripping the tiny communicator tightly, and yanked Paskaal forward by his neck. As Leanna and Paskaal fell, the device pulled loose. She landed next to Kieran and banged her head on the camera. The communicator tumbled from her hand as she winced and rolled into a ball. Paskaal thudded beside her, neck bleeding in a narrow line from the pulled necklace, and lunged for the device at the same time as Kieran.

The communicator disappeared, replaced by a glittering metallic sphere that Hegge had deftly tossed. The weapon hit the floor so hard that it sank in halfway, splashing out a small crater in the rotting osmotic cells of the fallen pagoda.

Kieran froze, looking at the uther. Hegge stood on his hind fluke, its long body arched in preparation for an attack. It carried another sphere menacingly in its hand.

"Matter of the communicator settled," said Hegge. "Dracowolf we are free to kill."

Leanna moaned, and Kieran turned to her, wishing he had reacted sooner and intervened before the fight had broken out. He checked her head and found a small lump. He gave Paskaal a scathing look.

Paskaal rubbed his neck and shrugged.

Leanna sat up, holding a hand on her hurt head. "Even if the dracowolf kills us, people will discover what happened here."

"Leanna, no. Possible it is that discovery of how we found this dracowolf will not happen. Discovered we may not be at all. Kill dracowolf we must, and then will you have your way."

"There are transponders in our wings," she lied. "Anybody can find us."

"I learn by attending classes of yours. Value your privacy, do you humans. Big air machines good at seeing and avoiding small things, like uthers. Devices for location finding not you carry."

The uther waddled forward and picked up the throwing sphere it had tossed. Kieran frowned as the uther grabbed the medallion, which had been undamaged by the impact. He had hoped that the uther would assume the device had been destroyed by the collision and leave it behind. *Maybe I can take it from Hegge by force?* He slowly reached for the throwing sphere in his belt pouch.

Hegge stared at him. "Determined, you humans are. To what end? If banished from Epona you are, bring who with you? Parents too? Research incomplete, dream of theirs destroyed by you? Neonates, are you still."

Kieran felt a surge of guilt and lost any thoughts about grabbing the communicator. The uther was right: the stakes had grown far beyond the simple tagging he'd received from sneaking out of the TELES boundary.

But banishment of my family will not happen if the authorities are kept out of the situation, he realized. Once back at TELES, he and Leanna could leak the information anonymously, which would stop the uthers from using the satellite information while preventing the banishment of anyone. All they had to do was survive the dracowolf, and hope Hegge would keep its implied promise that it wouldn't mention their interference to the authorities. Hegge got its hunt, but lost the newsfeed information. Leanna got the information stopped, but the dracowolf would die. A tradeoff for both.

He wondered why the uther didn't seem distraught about losing the useful news information. Was it because Hegge accepted it as an act of fate? Of course, Hegge could go back to the old hunting methods, so nothing really had changed.

"It all seems so . . . so unfair." Leanna sagged, covering her face with her hands. Kieran placed an arm around her

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shoulder to give her comfort while she grappled with accepting the tradeoff. She leaned into his side.

"Leanna, fair Nature knows not. What is, Nature understands. What is dictates what will be." Hegge walked back to the fenestration and glanced outside. "Enough time we have wasted arguing. Dracowolf not attacking yet is surprising—you humans confuse it I suspect still."

Paskaal looked at Kieran, still rubbing his cut neck. He appeared more resigned that angry. "You two stay right here. Hegge and I will have a better chance without any amateur interference."

Despite the ill feelings he had for Paskaal, Kieran couldn't help but finally ask, "You've done this before?"

He smirked, one that seemed cynical. "Who do you think has been giving Hegge the dracowolf sightings?" He turned around and stood through one of the trunk's holes. Hegge climbed out of an opening next to his.

"Why, Paskaal?"

Paskaal looked down at Kieran from his substantial height. "The uthers would have stumbled onto the information eventually. Why not?" He looked up at the sky, scanning for Epona's dragon.

Kieran reached out and tugged his pantleg. "*Why?*"

He stared forcefully into Kieran's eyes. "Things are boring here—too many restrictions. I found a loophole that got me involved in something I enjoyed doing. The uthers have been quite willing to trade the information for education in hunting methods." Using both arms, he lifted himself out of the pagoda log.

Is that why no one ever found a dracowolf after a sighting? he wondered. *How many dracowolves have Paskaal and Hegge killed?*

Leanna sniffled. Kieran felt a tear splash warmly on his leg.

At the loud flapping of wings, Kieran heard Hegge and Paskaal ascend. Feeling nervous and growing cold as the temperature dropped rapidly, his arms and legs trembled. He stood up, and looked out of a fenestration.

He saw Hegge push through the wide pagoda leaves into an open cobalt sky spotted with pink-tinted virga. Red sunlight highlighted the uther, making it seem a product of fire. Paskaal flapped below the canopy, a ruddy human dragonfly slowly drifting uphill, his eyes intent on Hegge.

Hegge climbed high, his tri-winged form becoming a tiny red silhouette next to a brightly shining star.

The nearby planet Sucellis, Kieran realized as he studied the brilliant dot, the uthers' next goal of conquest as they rapidly spread into their home system in their old-fashioned rockets—but with the newly acquired aid of human-made electronic guidance systems.

He wondered how that might look to the Elders: one culture a bit more advanced than the other introducing a host of new technologies and ideas. Would human influence on uthers be seen as good, or bad?

A distant flicker of lightning signaled from a patch of collapsing cumulus in the distance, a flash barely visible through the pagoda leaves. As if in response, several more bolts followed from different quadrants of the sky. Silence. No chirping silacopods, grunting ceretridons, or harmonizing avians.

Paskaal quietly landed on a many-branched neopagoda and waited.

Hegge banked and dived, pumping his wings in a fall that no human would have hoped to pull out of. A crimson shape flashed into view, large, streamlined, and, like its namesake, the giant avian trailed an unbroken stream of red "smoke" behind it—steam from its steady exhalation of body-warmed air. The dracowolf dived behind the uther, long, clawed limbs extended, open mouth forming a ring of talonlike chitinous teeth, the whole beast appearing like a creature from some ancient idea of Hades.

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The uther's apparent size grew so fast that Kieran was sure it would strike the trees. Hegge abruptly spread its wings and darted off to the right, passing above Paskaal's position, appearing more a blur than the pretty tri-winged form of an avian. Kieran could just barely hear the high-pitched whir of the dracowolf's sonar sweep. The titanic avian passed the spot where Hegge had changed direction. *Wait!* he thought, *It's not—*

As if a hurricane wind struck the forest, the dracowolf crashed through the flexible pagodas, shredding leaves, twisting and snapping trunks before they had a chance to bend, slamming entire boles to the ground. The beast grabbed Paskaal. With several powerful flaps, the dracowolf lifted above the trees, fanning them into a chaotic dance.

Paskaal's enraged yell echoed through the pagodas. He yanked his arm from the wingstraps and pulled out his sword. The dracowolf bit into his thigh with sharp teeth, a location protected by Paskaal's microweave jumpsuit. He planted the sword deeply into the beast's head. Twitching violently in pain, the dracowolf dropped Paskaal.

Paskaal plummeted through Epona's thin atmosphere, crashing through the thick trees. His wings tried to spread but couldn't do so in the confined airspace. He slammed into the ground with a decisive thud.

Kieran turned to Leanna. "Paskaal's hurt!"

Leanna looked at him in horror. "You'll be killed."

With those words he saw that Leanna had understood the tradeoff and accepted the dracowolf's fate—if there was to be a tradeoff this time. "He must be checked." He was surprised by the certainty, the acceptance, in his own voice. *Either that*, he realized, *or lose the battle with fear.*

Leanna jumped up and kissed him on the lips, an urgent move, one full of the desperation of the moment. She stared into his eyes, looking apologetic.

Kieran could understand her desire to find forgiveness, but there were better times for it. He gave her a quick hug and said, "Stay here."

Leanna nodded and crouched into the trunk's shadow.

He crawled out of the "log" and ran through the broken jungle, toward the unmoving form of Paskaal. The faint buzz of a sonar pass tickled his ears, and he glanced up. Hegge dove right at him, with the dracowolf shockingly close behind. Things became all too clear. "No!"

His rage in control, he launched straight up at the descending pair of avians. Thin air whistled around his head and rippled his clothing. He aimed for the uther, thinking, *You bastard.*

Hegge didn't try to dodge. The uther straightened out its push spear.

They collided.

Kieran felt hot pain erupt from his shoulder as the spear shattered his collarbone before sliding off his microweave cloth without penetrating. He hit the uther's head with his own, hoping his hard skull would have an effect on Hegge's much softer myoskeleton, and felt a shock that nearly made him black out.

Kieran's wings screamed with the increasing downward velocity. His hurt shoulder ached to the point of disorientation, yet he found the motivation to reach out and grab the uther's spear with his one functioning arm. Hanging from the shaft, he saw Hegge trapped in the dracowolf's long claws, struggling and flapping in the slipstream like a piece of leather, the crimson sunlight making the uther appear to be covered in blood. His blow had slowed Hegge enough for the dracowolf to catch, but the dracowolf had not slowed, and giant pagoda trees rapidly closed in below.

Venting his pain with a yell, he twisted the push spear out of the uther's weakened grasp and wielded it with his

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one good arm. His wings, spreading into safe mode, slowed his fall. Unable to brake as quickly as Kieran, the dracowolf shot forward. Dizzy with pain, Kieran sank the weapon into the beast's elongated torso. The shaft landed just behind the beast's brain. The dracowolf raced past. Kieran frowned.

Flapping wings that dwarfed the uther in its claws, the beast turned and lifted towards Kieran, gaining speed. Kieran watched the dracowolf wide-eyed. He couldn't maneuver with just one arm, and he couldn't think of anything else to save himself.

The push spear glinted under the ruddy sunlight—it had not shaken loose from the dracowolf.

Maybe if I hit it hard enough . . .

Tilting his body forward, he dove towards the dracowolf. The avian sent a series of deep pulses through him, heavy blows that made his hurt shoulder throb. The dracowolf dodged. Kieran tried to compensate, banking in the dracowolf's direction. But he wasn't balanced because of his hurt arm, and he just missed the shaft of the spear as the creature darted above him. His bag, weighted by the throwing sphere, caught the shaft, and swung around it in a tight wrap. Kieran, abruptly yanked upward, almost blacked out as the dracowolf twitched violently and went limp, flailing out of control, flipping, its wing membranes rippling like the skin of a deflated balloon. As one, the dracowolf, Hegge, and Kieran fell.

The uther found the will to speak, singing into the gale, and Kieran's translator coldly pumped the information into his ear. "My path, I hoped, would continue easy dracowolf hunts, had Nature so deemed. Leanna is correct. Hunting became too easy. New technology brings new responsibility, I now understand. New technology also makes unnecessary the dracowolf hunts. End I must, with the old ways."

The dracowolf's cathedraltree roost drew disturbingly near. Kieran freed his arm, unstrapped his belt, and fell out of control, his wings streaming behind him, whistling viciously as his velocity increased. His foils straightened out, rapidly slowing his fall. Streaming past, the dead dracowolf and injured uther rushed towards the jungle.

The dracowolf crashed into the base of the cathedraltree, cleanly punching thorough the hollow trunk, producing a sickening fan of liquefied osmotic muscle that splashed wetly throughout the forest. The cathedraltree tilted, ninety meters of pagoda roaring through the air like a giant fan, its leaves rippling like tattered skirts to the insistent pull of air. With a thunderous noise, the ancient tree slammed into the ground tier after tier, crushing hundreds of lesser pagodas under its titanic weight, yanking down whole trees like weeds underfoot, making the ground appear to collapse as the whole forest canopy fell around the stricken leviathan. A blizzard of shredded leaves and gyrating branches thrown high by the pagoda's wake quickly obscured the violence below, and the wash of debris rapidly billowed toward him.

Caught in the tree's turbulence and unable to stop his fall completely, Kieran punched through the flying pagoda parts. He realized that the cathedraltree was falling toward the log where Leanna hid. The memory of Tripod's falling cage flashed before his vision with surreal clarity, as did the flying throwing sphere and dead pet rock. *Not again!* he thought with sudden despair. Then he hit the ground.

Kieran awoke to the sound of soft crying. "Please wake up, Kieran. Hegge and Paskaal are dead." She said the names quietly, as if she were in a daze. He felt Leanna's hand on his shoulder and forced his tired eyes to open. A faint rosy dusklight added a dim illumination to a shattered jungle and Leanna's dirty, leaf-shred covered face.

Leanna looked at him with tear-

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soaked eyes. "They're gone! And . . . and it's my fault."

Kieran forced himself to sit up and winced as he felt a searing pain in his back and shoulder. Broken ribs, he was sure, as well as his ruined shoulder. His right ankle wasn't in much better shape, and he wondered if he could stand. Remembering the crash of the cathedraltree, he took a painful breath and asked, "How'd you—"

"I," she sucked in a deep breath, "I almost didn't get out in time."

He nodded. "I'm glad you did."

Leanna nodded, and tried to smile, a brief upcurling of her lips. She held up the communicator. "I got this off of Hegge, and called a rescue. They'll be here soon."

"Where's Hegge?" Kieran asked gently. He coughed, and the pain nearly made him collapse.

"He's up there." She pointed along the length of the broken cathedraltree. Its trunk appeared uncannily relaxed as it followed the contours of the hill.

"I'd like to see Hegge," said Kieran.

Giving him a concerned look, Leanna said, "You shouldn't move."

"Even so—this will be my only chance."

"Do you need help?" She wiped water from one of her eyes.

Kieran nodded, saying, "I can only use my left leg. Help me stand."

She supported his right side, and guided him painfully to his feet. Stepping slowly, she led him up the debris-covered slope.

He saw Hegge and felt tears of his own beginning. The uther was smashed almost beyond recognition. Kieran's leg buckled and he dropped to his knees. A queasy feeling grew in his stomach.

No longer did he feel anger towards the uther, despite what it had attempted. *Crushed by gravity, just like the pet rock*, he thought. *Or more like dying from a shattered world, like Tripod in its fallen cage.* How much more of this subtle disruption would happen? All simply due to human and uther interaction.

"Better off this way, is it not?" he quietly said to himself. "We're free to end the dracowolf hunts." *But Paskaal's dead*, he thought regretfully.

"I didn't want things to end up this way!" Leanna turned and sobbed.

"The uther accepted its fate long before this," Kieran said, feeling saddened that it took the uther's death to understand its motivations. "'Some must end with the old way of doing things,' I suspect Hegge would say, 'as surely as the clouds part at the end of a rain.' I don't think Hegge would understand someone feeling guilt for what has happened."

"I—I don't quite see it Hegge's way. I awoke the dracowolf, and now Hegge . . . and Paskaal . . ." She sat down and held her head low. "I don't want to stop the hunts anymore—not if it means more uthers dying or despairing over an end to their ways that we humans initiated by simply being here. How many uthers have already died from our intervention? How many humans?"

Unable to answer her questions, Kieran looked at the dead dracowolf's broken body. He couldn't help but think that he had just witnessed the answer to the Elders' silence. The Elders probably didn't interfere with developing civilizations. Too much potential for the kind of grief he had just seen.

But the Elders were not his biggest concern.

There was a dead dracowolf—or pseudodracowolf, depending on who you believed. Paskaal and Hegge were also dead. He had a broken shoulder that came from Hegge's push spear—a cyberdoctor would be able to decipher that. He wasn't about to try to lie. The authorities would figure out what happened.

When we're banished from Epona, he thought fearfully, *will Mom and Dad let me see Leanna?*

He wasn't sure. But he had hope.

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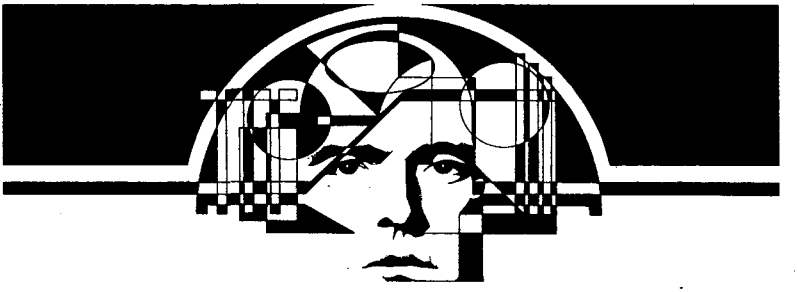
A change needed to be made in the way encounters with alien sophonts were handled. So much time had passed since the first uther-human contact that little could be done for the Eponans. Human and uther were deeply intertwined, for better or for worse. However, when another intelligence was discovered, they should be left to themselves. He was sure others were already working on this problem, and he would find out who. Maybe he and Leanna would be allowed to work on this project together.

Kieran suddenly felt weak. "Let's sit."

Leanna helped him down and sat next to him. The soft bubbleweed underneath him offered some comfort. He grabbed Leanna's hand. Preparing to face his own shattered world, he awaited the air rescue's arrival. ■

(Editor's note: You can read more about Epona in the author's special feature "Epona" [November 1996] and G. David Nordley's "Fugue on a Sunken Continent" [November 1996].)



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Chat with **Gardner Dozois**, Wednesday, September 23, 1998 and **Geoffrey A. Landis**, Monday, October 12, 1998. Both chats will be at 9:00 PM(EST).

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Alexis Glynn Latner

Catching the Wind From the Sun

The Genesis Mission is not glamorous, but it is important!

The last Apollo moon rocks, brought back to Earth by Apollo 17, arrived at the Lunar Receiving Laboratory at Johnson Space Center in late 1972. The JSC lunar collection came to be housed in a specially designed curation building called the Lunar Sample Facility. In 2003, a collection of particles from the solar wind will be returned to Earth by Genesis, the solar wind sample return mission. Just like the moon rocks—and in fact in the same building—the solar wind sample will be analyzed and curated for future analyses.

The more things change the more they stay the same, right?

Not really. For one thing, the whole context of bringing back extraterrestrial material has changed since 1973. Astronauts haven't ventured beyond low earth orbit for a quarter of a century. The entity most recently prodding rocks on another world was the competent little Mars robot Sojourner.

Also, it's one kind of technical and logistical challenge to collect rocks and keep them pristine all the way back to a lab on Earth. Almost nothing is the same

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when what you plan to gather, bring back, and analyze is a trove of *atoms.*

Why Does it Matter what the Solar Wind is Composed of?

The Sun exhales unsteady gales of ions and electrons, particles blowing across the solar system to the boundary of the heliosphere, where the attenuated wind from the Sun meets the faint pressure of the wind from the stars. The solar wind doesn't strike the face of the Earth directly. Our world's magnetosphere mostly deflects the plasma streaming from the Sun. Assorted boundary effects between the solar wind and the magnetosphere include the auroras. Most other worlds, including the Moon, lack the umbrella of a magnetosphere. Meteors drift naked in the heliosphere.

In 1956, chemists Hans Suess and Harold Urey published a paper in which they made two bold assertions. First, that noble gases trapped in meteorites were indeed put there by the solar wind. Second, that the solar wind tells us something about the composition of the Sun itself.

Suess had previously identified the relationship between abundance and mass of elements in the solar system. Lighter elements are more abundant, starting with hydrogen, the most abundant of all. It's not quite a function of atomic number—the number of protons in the nucleus. Rather, it's a function of atomic *mass*—protons plus neutrons. The variations of an element's atomic mass due to more or fewer neutrons in the nucleus are its isotopes. Suess realized that isotopes matter a great deal in the structure of the Solar System.

Harold Urey had discovered isotopes, starting with deuterium (the proton-plus-neutron isotope of hydrogen). He went on to study planetary atmospheres and then meteorites.[1] In their 1956 paper, Suess and Urey together hypothesized that the solar wind reflects the composition of the Sun, isotopes and all.

A detailed analysis of the solar wind would reveal exactly what the Sun is made of—and how the Sun's worlds began.

The Sun represents more than 99 percent of the mass of the solar system. Its layers of atmosphere reflect the composition of the original solar nebula. The bulk of that primordial swirl evolved into the Sun while the outer reaches became planets. Through processes not yet fully understood, planetary formation resulted in rocky planets, plus or minus magnetospheres; gas giants; comets; asteroids; varied planetary atmospheres; and, in at least one localized case, carbon-based life forms. The Sun changed less. It approximates what the planets changed from.

During the Apollo program, a series of solar wind foil experiments went to the Moon. Thanks to the Apollo foils, there is one precisely known solar isotope ratio, that of 20 neon to 22 neon. The ratio is 13.7—which is not the ratio found on Earth. Evidently, some atmospheric escape mechanism preferentially lost the lighter isotope of neon during the evolution of the Earth.

Data like the neon ratio can validate atmospheric escape models. And atmospheric mechanisms are deeply implicated in the processes of planetary formation. The Apollo foil results confirmed the intuition of Suess and Urey: how important it is to do a comprehensive analysis of the solar wind's composition.

Out of all of the elements, though, only neon and helium could be analyzed in the Apollo samples. Three days' worth of solar particles hitting a flag-sized sheet of aluminum foil wasn't much. Solar wind flux ranges from 10^4 to 10^5 atoms/cm^2/s for various elements. To intercept enough flux for meaningful analysis of many elements takes a fair amount of time and collecting surface.

You could hang collecting sheets on a clothesline in the backyard of the (nonexistent) lunar farside base. Or you could send an unmanned spacecraft

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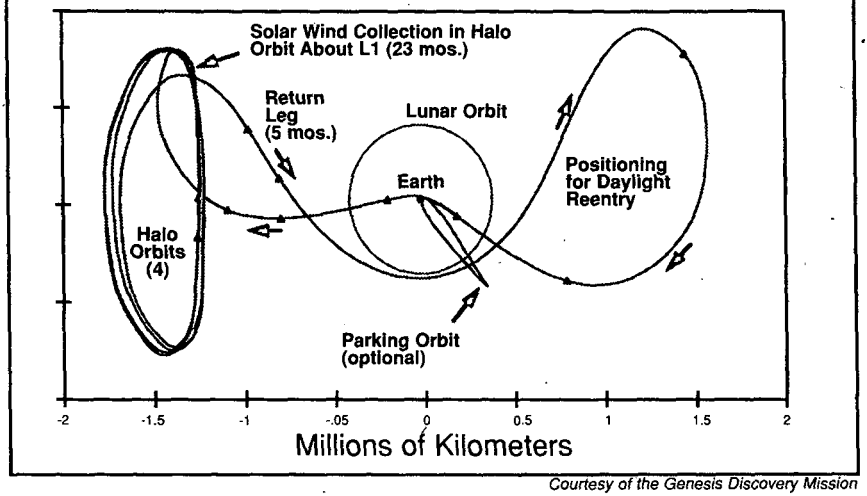
Fig. I: Solar Wind Sample Trajectory



Courtesy of the Genesis Discovery Mission

beyond the Earth's magnetosphere to unfurl a collecting surface, intercept the solar wind for months on end, then pack itself up and come home.

The Suess-Urey Proposal

While humans have not gotten far from Earth since Apollo, the technology of solid-state circuitry, telecommunications and telerobotics has come an amazing distance. Spacecraft can send back immense quantities of data on a thin telemetry thread. Robots can undertake complex tasks in harsh and remote environments. It's now feasible to do hands-on planetary exploration without astronauts, man-rated launch vehicles, and billion-dollar programs, as long as you have *some* money.

In the mid-1990's, NASA started the Discovery Program: small, quick missions to do science for less than $200 million apiece. The first Discovery Mission was the Near Earth Asteroid Rendezvous (NEAR). Mars Pathfinder got the green flag next.[2] Planetary scientists seized the opportunity to propose sending experiments to visit Mars and Venus and sample asteroids and comets—and the solar wind.

In 1993, Dr. Donald Burnett of Cal Tech assembled a small group of scientists and engineers to think up a solar wind sample return mission. Burnett and his team envisioned a Discovery Mission called *Suess-Urey*.

The Suess-Urey concept is straightforward. A small spacecraft goes beyond the boundary of Earth's magnetic field to the Earth-Sun Lagrange libration point L1. At L1, the gravity of the Earth exactly counterbalances that of the distant Sun. Unlike the L4 and L5 libration points, L1 is *unstable*: it's somewhat like the difference between the bottom of a valley and the top of a hill. The spacecraft establishes a halo orbit around the L1 point. A collecting array opens up, so positioned as to be continuously exposed to the wind from the Sun. Two years later, the spacecraft returns to Earth. Its solar wind sample, sealed inside a science canister, falls to Earth to be retrieved for laboratory analysis.

Discovery proposals all go through the gauntlet of two review panels—one for science, the other for technical, cost and other considerations. A Discovery Mission has to be expeditious (no

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decade-long development time). And it has to cost less than two hundred million dollars with launch on an expendable rocket. (Experiments that have to be hand-carried by astronauts on EVA need not apply.)

Discovery Mission finances rule out putting lots of specially designed, flight-tested instruments on board to analyze the data. But sophisticated analysis of atomic ions, which are vanishingly tiny, takes a big stable of instruments. That means bringing a solar wind sample back to Earth.

No matter what the analytic means, a Discovery proposal has to guarantee good scientific results. NASA is reluctantly prepared to lose a Discovery Mission by accident: rockets can blow up on the pad, and a meteor could take out a particularly unlucky spacecraft. But wishful thinking about how well an experiment will work has a hellbent snowball's chance of surviving the science review panel.

In the case of the Suess-Urey proposal, the investigation's feasibility depended on contamination control. The proposal had to prove that the solar wind sample would not get mixed up with misleading atoms from Earth before, during, or after the actual mission.

Contamination Control

Unanalyzed lunar samples reside in an ultraclean facility with a pure nitrogen atmosphere, lest something in Earth's environment subtly contaminate the rocks and skew eventual analysis. (The Lunar Sample Facility is tornado- and hurricane-proof in the event of not-so-subtle agencies.) Consider, though, the logistical problems entailed in making sure that a sample of highly-assorted atomic particles collected in space is unpolluted enough for meaningful scientific analysis in a laboratory on Earth.

The spacecraft sent to take the solar wind sample teems with atoms. So does whatever material is used for a collector. And any practicable method of handling, cleaning and analyzing the collecting material exposes the sample to extraneous atoms.

In terms of keeping anything clean, atoms are worse than germs.[3]

Contamination control begins with a collecting material that has both *bulk purity* and *surface cleanliness*. The material's atomic composition must be remarkably free of impurities, in order for the solar wind sample to be distinctive; additionally, it must be possible to keep the surface very, very clean. It turns out that the best material to collect a solar wind sample is silicon wafers from the semiconductor industry.

The Suess-Urey mission proposal specified that the science canister be precision cleaned and the silicon wafers installed in a special clean room. The canister would remain sealed until the spacecraft settles in at L1.

In space, contamination rears its ugly head. On the atomic level, a spacecraft is exceedingly dirty. It exudes a cloud of atoms from outgassing of lubricants, hoses, and wires, reminiscent of Charlie Brown's friend Pigpen.

Just as on Earth, but more so, stuff in the vacuum of space tends to stick to cold surfaces and depart from hot ones. Thus the *bakeout* stage of the Suess-Urey proposal. The sample return capsule, containing the sealed science canister, opens up like a clamshell, facing the Sun. This bakes most contaminant atoms and molecules out.

Once on station at L1, the science canister opens. The collector arrays swing out into position to intercept the particles from the Sun.

Chance being what it is, an array of shiny wafers offers a tempting target for micrometeoroids. Strikes can be expected to spall the surface, releasing bursts of material.

The Suess-Urey proposal assessed micrometeoroid abundances and spalling processes, which entailed shooting solid particles at silicon wafers in the lab. The conclusion was that the predictable

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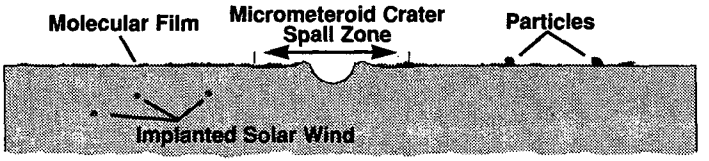
Fig. 2: Summary of Surface Contamination



Courtesy of the Genesis Discovery Mission

wafer casualty rate is acceptably low. And the amount of vaporized material that settles on the wafers won't compromise the later analysis.

The whole time on station, the spacecraft's own ablation shield merrily continues outgassing. The ablative material is a distinct contamination hazard, as its whole purpose in life is to disintegrate, absorbing the heat of re-entry into the Earth's atmosphere in the process. So there is no line of sight between the ablation shield and the top of the collector arrays. For that matter, there's no line of sight between the collecting surfaces and any part of the spacecraft. Outgassing molecules have to undergo many collisions to ricochet back toward the collectors. Most won't.

The spacecraft's thrusters constitute a lesser, but still real, contamination source. Even though L1 is a libration point, the spacecraft tends to drift and wobble. The collector array must remain facing the solar wind. Minor corrections in the spacecraft's attitude and location necessitate the use of position thrusters. And position thrusters release great gouts of atoms—fortunately directed away from the collector arrays.

Outgassing, micrometeroid spalling, thruster gases and other insults deposit contaminating atoms on the collector plates. The unwelcome depositions may necessitate cleaning in the laboratory before analysis commences. To compound the problem, there isn't much sample to begin with. Even after two years, the whole solar wind sample will only amount to 10^{17} atoms.

The $200 million dollar question for the Suess-Urey proposal was whether an elemental and isotopic signal could ever be separated from the atomic "noise." Depth of penetration proved to be the key to the answer.

In the end, there are two basic types of contamination to contend with: particulate material such as dust and flakes, and molecular film from ground handling, spacecraft outgassing, station-keeping thrusters and micrometeoroid impact vaporization. Virtually all of this stuff has drifted onto the wafers, rather than plowing in. Contaminants adhere to the first few nanometers of the collecting surface.

The solar wind, on the other hand, gusts at hundreds of kilometers per second. Solar ions will embed themselves in the top hundred nanometers of the material. Since a nanometer is a billionth of a meter, that's not much depth by any everyday measure! But it's far enough to distinguish implanted sample from superficial depositions.

The Suess-Urey proposal made a solid case for the fact that solar particles would be distinctive enough to analyze. Solar wind sample return would be both feasible and productive.

That didn't mean the mission would ever fly.

The Genesis Discovery Mission

The Suess-Urey proposal went up against stiff competition. Another Discovery proposal that year was Stardust, a mission to sample a cometary coma and interstellar dust, trapping the matter in aerogel and returning it to Earth.

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Stardust won selection in 1995. Don Burnett and his team felt they had a near-winner, though, and resolved to try again at the next opportunity. They honed their proposal.

The question arose as to whether contamination control really mandated cold gas thrusters to maintain the spacecraft's position. Conventional hydrazine thrusters would be lighter, cheaper, better flight-tested . . . and dirtier.

Thruster comparison ended up to be one of the most excruciating assessments in the whole contamination control process. But the outcome was that conventional thrusters would work, given ultrapure hydrazine and some design modifications to the spacecraft's equipment deck.

By the 1997 review, the solar wind sample return mission had been thought through very thoroughly indeed. And the mission had a new name: Genesis.

Suess-Urey referenced the mission's intellectual parentage. *Genesis* heralds the implication of Suess's and Urey's work: that solar wind sample analysis will reveal how the solar system began.

In October of 1997, the review panels were convinced. Genesis was selected along with CONTOUR, a flyby of three comet nuclei. The Suess-Urey proposal had become Genesis, Discovery Mission 5. With only 3 years until launch, the project went into high gear.

The spacecraft is being built by Lockheed Martin Astronautics. The Jet Propulsion Laboratory is in charge of the science canister. Another partner in scientific hardware is Los Alamos National Laboratory; LANL is building a concentrator—an electrostatic mirror to focus particles on a special chemical vapor deposit (CVD) diamond surface. The concentrator exists to capture an important minority of the lighter solar wind ions, especially oxygen.

Johnson Space Center is where technicians will fit the collector wafers into the array trays. Fifty-five hexagonal wafers go into each of 5 round, platter-like trays. In addition to silicon, there will be a few wafers made from other materials: aluminum, for noble gases in particular; germanium; and gold/platinum, for heavy radioactive ions.

Fully assembled, the Genesis spacecraft will be about the size of a dining room table and fit atop a Delta II rocket. Launch from the Eastern Test Range is slated for January of 2001. The spacecraft will reach L1 three months later.

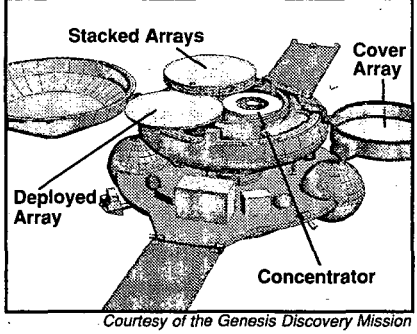
At L1, the science canister lid will swing open. The lid contains the "bulk detector array." Within the canister itself are stacked the other four arrays. The bulk array and the top array in the stack will be permanently deployed to catch all of the wind coming their way. The other three arrays have been designed for different kinds, or regimes, of solar wind: the slow interstream regime, the fast coronal hole regime, and the coronal mass ejecta.

An ion monitor and electron monitor will detect which regime is present at a given time. The collector arrays will shuffle accordingly, with the ones needed being exposed to the Sun, the others sheltered by stacking, Genesis trimming its sails for various winds from the Sun.

After twenty-three months, the arrays will return to the completely sealed configuration for return to Earth.

The sample return capsule ultimately separates from the rest of the spacecraft

Fig. 3: Sample Collection at L1



Courtesy of the Genesis Discovery Mission

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to return to Earth. An ultrapure filter equalizes atmospheric pressure inside the canister on its way down through the atmosphere. In a blaze of ablative glory, the capsule will fall toward the Utah desert.

West of Salt Lake City and out in the middle of nowhere, the Utah Test and Training Range has 52 radars. That makes it more feasible to pinpoint a small incoming object than if the capsule came down at sea. Losing the canister in the depths of the ocean would be the worst possible outcome of the mission.

Best possible outcome is that the science canister reaches the ground gently. The capsule will deploy a conspicuous rectangular parachute. Military helicopters will proceed toward the chute. At about 11,000 feet above the desert, the helicopters will attempt to snag the dangling canister in midair. To be exact, the 'copters can make a maximum of six passes each, for a total of twelve tries in as many minutes.

In case the mid-air retrieval fails, the science canister has collapsible struts. These could absorb much of the shock of impact on the ground, which at UTTR happens to be spongy ancient mud. In a near-worst-case scenario the capsule impacts the ground hard enough to shatter the collectors. But the five collector arrays each have a different thickness. If necessary, five silicon jigsaw puzzles can be pieced together in the lab.

Remaining sealed, the canister will be transported to JSC for analysis. Then the really good part—scientifically speaking—begins.

Analysis and Curation

The Genesis mission calls for the solar wind sample to be analyzed for the presence of every element from lithium (atomic number 3) to uranium (92) including all the isotopes along the way. It won't proceed in atomic-numerical order. Analysis will start with the elements of greatest interest in theories of planetary formation. Oxygen leads the list.

Several flavors of mass spectrometry will be brought to bear on the sample, plus other techniques including radiochemical neutron activation analysis (RNAA). Practically every element will require a different technique if not a different machine. Some elements and isotopes can only be assessed by advanced instruments that haven't been built yet. For that reason—and the fact that we don't necessarily know all of the right questions right now—the whole Genesis sample will not be used up any time soon. Much of it will be curated for the future.

Curation is an important concept. Moon rocks have been fastidiously preserved all along. Every so often another sliver here or slice there is subjected to a test that did not exist in 1973, with new results. Also, the famous rock that may or may not point to life on Mars spent two decades in curation after it was found in Antarctica. It was not identified as Martian until 1993. The researchers obtained the rock from the curatorial facility.

For years to come, researchers will request shards of collector material from Genesis. Interestingly, though, the first round of requests will be for money. Upon launch, the Genesis mission will invite researchers worldwide to propose advanced new instruments to study the solar wind samples.

Pieced together around the world, the Genesis results—a thorough understanding of the composition of the original solar nebula—will factor into the interpretation of a vast variety of space data. By one estimation, Genesis may shed light on the scientific results of almost forty other space missions past, present—and future.

Other Sample Return Missions

By January of 1998, the location of the site for initial analysis and permanent curation of Genesis material had

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been determined. It will be the Lunar Sample Facility, Building 31 North at JSC.

In one corner of the building's ground floor, a controlled environment—actually on a par with 1970's era clean rooms—is where "used" moon rocks, the ones that have already been subject to analysis, are kept. Here is where the Genesis facility will be constructed, relocating the used rocks. Genesis will also remodel an adjacent room. Now used to store hammers, sample storage boxes, and so forth, it used to be the public viewing area for moon rocks.

The Genesis facility will have room to accommodate more than just a priceless store of atoms. Stardust intends to bring home cometary and interstellar dust. Japan's Muses-C is an asteroid sample mission from which JSC expects to obtain a piece. And one day the Sun atoms, comet dust and bit of asteroid will be joined by rocks from Mars.

A compelling scientific case can be made for interplanetary sample return to Earth. The advantage of sample return over *in situ* analysis is threefold. First, even if the sample is tiny, a big array of laboratory instruments can wring incredible detail out of it. Second, most such studies are repeatable: Multiple investigators and multiple analyses can corroborate an accurate conclusion or reveal an erroneous one. And third, samples can be curated as a reservoir for future methods, instruments and questions.

At present, the missions named above are the only sample returns being planned. Scientific antennae quiver at the possibilities, though.

Researchers on Earth would very much like to analyze a piece of ice from the Moon. Further afield, in the next few decades, robots, if not manned missions, will probably reach such places as Europa and Io. Any samples brought back would be appropriate for analysis by Genesis instruments.

Given the far-flung set of powerful analytical instruments that the Genesis sample will precipitate, it is irresistible to speculate about what else they could be used for. Maybe there's something in our solar system we don't know about because it's too subtle and smokelike for us to have discovered yet. Or maybe something will arrive—diaphanous, tantalizing and unknown; if only a stolen wisp of it could be obtained, then the instruments from Genesis would be better than anything else on Earth for making sense of it.

What's Written in a Piece of the Sun

Compared to other planetary missions, whether real or imagined, Genesis is not sexy.

Solar wind sample return does not involve aerogel, a cute robot, or a brief flurry of activity to capture the public's interest. According to plan, Genesis will remain in one obscure place not doing anything to attract much attention for a long time.

So did the Rosetta stone.

Until philologists discovered that it was the key to deciphering the great mystery of the ancient language world. The ultimate, exhaustive analysis of the Genesis sample might do something very much like that for the worlds that we know in the future.

More than any other single mission planned as of now, Genesis will help us find out how our solar system, complete with the blue home planet, began and evolved. Perhaps even how our planet is highly unique. Or not.

Those questions were framed by the work of Suess and Urey. Seeking answers, Genesis will continue solar wind experimentation where Apollo left off.

Not incidentally, Genesis will also obtain NASA's first extraterrestrial sample since Apollo, bringing it to JSC on a set of silver (or rather, silvery silicon) platters. At that point, in however small a way, NASA will once again be in the business of bringing scientific samples home from other worlds.

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But it won't be the same as Apollo.

Sending human beings to the Moon to get rocks and soils in person seemed important. And in truth it was important: if not for the quality of samples collected, then for the occasional capers between sample-getting and experiment-deploying. A world full of human beings saw a few of their kind bouncing, jumping, or hitting a golf ball, in a gravity well shallower than Earth's and full of possibilities.

The Genesis spacecraft won't caper at L1—or, if it does, the mission scientists will be quite upset. Genesis is designed to do something sedate but utterly irreplaceable: collect solar wind, ion by ion, for two years, then return those particles to Earth for the most sophisticated atomic analyses in the world.

You can think of it as bringing back a piece of the Sun.

And unlike such destinations as the Moon, Mars, or asteroids, the Sun is one place where human beings would definitely not want to go to collect samples. □

Notes

1. Urey won the Nobel prize for the discovery of deuterium. He also wrote the classic 1952 textbook titled *Planets*, which became the foundation of modern planetary science. It was in Urey's lab that the famous atmosphere experiment with Stanley Miller resulted in what seemed to be compounds on the way to becoming life. The remarkable Dr. Urey made contributions to meteorite science up into his 80s.
2. In his February 1998 *Analog* editorial, Stanley Schmidt pointed out that $200 M works out to something like a dollar per American. It's less, as the US population is more than 200 million. Consider that Mars Pathfinder with the robot Sojourner charmed America in 1997 when a movie cost $6 and up, and taking a family to a baseball game cost $60. Quite apart from the incalculable value of discoveries in planetary science, under a buck was a heck of a low price for admission to the Pathfinder show.
3. Not that germs are easy to deal with. Part of NASA's Planetary Protection Plan for the return of Mars samples to Earth is extensive testing and analysis of seals. It's extremely difficult to make sure that viral matter does not perfuse a seal. NASA is consulting the Centers for Disease Control (CDC), which has a great deal of experience in this regard.
4. By this point in the speculative process, any NASA scientist speaking on the record has long since bailed out, refusing to guess what the space agency or the Universe will do. What follows is science fiction.

Resources

Apollo Solar Wind Experiments Web Page (as of 2/98): http://www-sn.jsc.nasa.gov/explore/Data/Apollo/Part1/SWC.htm
Discovery Program Web Page (as of 2/98): http://discovery.larc.nasa.gov/discovery/home.html
Genesis Public Web Page (as of 2/98): http://www.gps.caltech.edu/genesis/
Lang, Kenneth R. *Sun, Earth and Sky*. Berlin: Springer, 1995.
Rapp, et. al. "The Suess-Urey Mission (return of solar matter to Earth)" in *Acta Astronautica*, 1996, v.39 n1/4 p. 229.
Urey, Harold C. *The Planets*. New Haven: Yale University Press, 1952.

The author gratefully thanks Dr. Eileen K. Stansbery, who is a planetary scientist at NASA-JSC and a member of the Genesis team, for explaining everything in patient and thorough detail, and some things more than once.

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Jerry Oltion

KISSING COUSINS

It's hard to tell where a new technology will lead—and once you've started down the path, some steps can't be retraced.

Illustration by Shirley Chan

The trouble with planets is, they're big. I never really thought about it much when I was living on one—nor after I'd died, for that matter—but they're huge.

It's not intuitively obvious. The horizon is only three miles away on Earth, two on Mars, and less than that on any of the settled moons. Nothing you can see even from a mountain peak is farther than an hour's flight away. And when you're in orbit around a planet, well heck, the whole thing rolls past in the time it takes to enjoy a good lunch. But just try picking a landing site on one you've never seen before. All of a sudden they look enormous. Tilbey and Liam and I were overwhelmed from the moment we first saw Islandia.

We called it that because it was the only name that could possibly do it justice. There wasn't a continent anywhere larger than Great Britain, and precious few that size. On the other hand, there wasn't an uninterrupted stretch of water bigger than the Mediterranean. The whole thing was one big archipelago, a sailor's delight and an explorer's nightmare. I mean, where do you land when every place looks pretty much like every place else?

After spending five years as an artificially enhanced ghost with my senses turned down to conserve power, cooped

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up in a spaceship with two other guys who missed their live bodies just as badly as I did mine, I didn't care. By the time we finally decelerated into the Alpha Centauri system and began looking for planets, I would have landed on molten rock if I'd had to. Anything for some external sensory input. When we realized Islandia might even have life on it, I let out a whoop of delight and led the charge for the lander before our starship, the *Spook*, had even achieved orbit.

One of the nice things about being a ghost is that you don't have to worry about whether or not you can breathe the atmosphere or eat the food, and you don't even worry much about the aliens eating you. The mass-eliminators that generated our "magnetically enhanced post-vivo standing waves" were still safe in orbit. If something attacked us, all we had to do was turn down the coupling constant that governed our interface with normal matter and we could thumb our noses at a raging tyrannosaur. Heck, we could thumb our noses *inside* a raging tyrannosaur if he kept coming; with the constant down below 20% or so he'd hardly feel us as we slipped through him.

He'd probably twitch a bit, though, as we shorted out his nervous system. We tend to disrupt just about anything electrical, including nerve impulses. That meant we had to be careful around anything electronic or anything alive. We had to put magnetic grapples in the *Spook* to keep us from falling through the decks and blowing every circuit in the ship under the fifty *g*s of acceleration it was capable of, and the lander had the same capability, but fortunately we wouldn't require such drastic measures just to go down to the surface. For that we would only pull a couple of *g*s, so we just cranked up the coupling constant before we launched, strapped ourselves into the acceleration seats like regular astronauts, and told the autopilot to take us down.

We wouldn't even have had to do that if we didn't want to. We could have swum down, flapping our arms against the planetary magnetic field for propulsion, but that was a slow, laborious way to get anywhere. Besides, when we got into the atmosphere we would have been blown every which way like getaway birthday balloons.

I was perfectly happy to ride down in comfort in a seat. So was Tilbey. Liam fidgeted, but he's an ex-pilot and he no doubt thought he could do a better job than the computer. Or maybe he just wanted to play with the controls. It had been a long time since he'd last done it. That's why I didn't suggest he have a go at it now. A crash probably wouldn't hurt us any more than a wild animal would, but it would screw up the lander royally, and then we'd have to swim everywhere, like it or not.

We watched the heads-up displays as the autopilot brought us down through the atmosphere. We'd picked an equatorial island where the time of day was about the same as what we were used to on the ship, and when we got close enough to see detail we picked a sandy spot above the high-tide line where forest, grassland, and ocean all came together. It seemed as good a place as any to start, and as we drew closer it looked better and better. Sunlight—Centauri-light?—glinted off the gentle waves, the beach sparkled like snow, and a flock of seabirds took wing at the sound of our approach and circled around our landing site almost like an invitation.

Then the naked women came out from the forest to see what all the commotion was about, and we knew we had come to the right place.

They had dark skin, dark hair, and, big, round . . . well, my attention focused about chest high. It had been a long five years on board the *Spook*.

There were five women. They retreated into the woods when the lander drew close, but they came right back out again after we touched down. Tilbey was the first of us to break the

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stunned silence as we watched them take a few cautious steps toward us. "They're, um, they're human," he said.

Good first words spoken from another world. Pity none of us had wits enough to turn on the data recorder. We were all staring slack-jawed out the windshield. Then Liam unbuckled his harness and stood up. "I've got to see this firsthand."

"Me too," I said, doing the same.

"Last one outside is a dead man!" he shouted, and he whooped for joy as he leaped for the airlock.

"Wait!" Tilbey yelled, but we didn't even slow down. He unbuckled and rushed after us, squeezing into the airlock just as the door thumped shut behind him. The outer door was already opening when he said, "How do you think they're going to react to us?"

He had a point. The mass eliminators back on the *Spook* that regulated our ghostly existence didn't provide us with clothing. Nor did they provide color. We were three milky white naked guys, even Liam, who had started out life darker than the women outside. Even though we looked solid enough with the coupling constant set to "high," that might be a bit of a shock to them.

When the airlock door slid aside, we stood there like embarrassed teenagers on the way to a hot tub party who had hit the "lobby" button in the elevator by mistake. I felt the tingling in my pseudoskin that would have been a blush if I'd still had red blood coursing through my body.

The women paused in their advance, craned their necks, tilted their heads—all the stuff people do when they're curious. They spoke to one another with soft, liquid voices in a language we didn't know. That was actually a comfort, because if they had spoken English—or even Swahili—to us, I think my brain would have exploded. I mean, this was Alpha Centauri. We'd travelled 4.2 light-years to get here, and we were greeted by human women?

I had no doubt they were human. Pheromones, visual cues; I sensed their origins in a dozen different ways, and all of them agreed: we were the same species.

The women giggled when they noticed our reaction. Then they giggled some more when they saw what their giggling did to us. They stepped closer.

The airlock door was beside one of the landing legs. We didn't have a ramp to walk down; we had to turn around and climb down the ladder on the leg. That meant each of us mooned the greeting party as we descended, but that seemed little more embarrassment than we'd already suffered. I heard more giggling as they watched us work our way down.

Liam went first, so he got to decide how to greet them. He took a safe approach, holding out his hands palms-out and saying, "Hi, my name's Liam. Nice to see you."

One of the women held her hands up the same way, hesitantly at first, then more confidently when Liam smiled at her. She pressed her palms against his, then said something fluid and musical. She turned to me and held out her hands, so I said, "I'm Danny," and we touched palms. Hers were warm. I didn't know how mine felt to her.

She moved to Tilbey, and then the other women wanted to touch, so we all did the palm thing, one after the other. I wondered if that was their natural way of greeting, or if we'd just inadvertently invented a new custom.

We spent the next few minutes sorting out names, learning the words for "rock" and "sand" and so on. Or maybe we'd just learned how to say "right breast," "left breast," "hard," and "white." It would take a while to sort things out. We weren't in a big hurry. We'd crossed the gulf between stars, found an inhabited planet, and the natives were friendly. We were in explorer heaven.

* * *

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There were men on the island, too. Most of them had been up in the forest hunting giraffe or something when we landed, and they'd been successful at it, so we had quite a feast that night. With our interface turned up as high as it was we could actually eat what they cooked, too. And even taste it, though I'd discovered not long after I'd become a ghost that food and drink didn't metabolize inside us the way it had when we were alive. We would have to go off by ourselves later on and lower our coupling constant enough to let it all fall through us. In the meantime, even though it didn't do us any good, it didn't do us any harm either, and it always helps any social situation when you eat what your hosts offer you.

There were about forty of them altogether, counting maybe a dozen kids. Everyone was curious as cats about where we'd come from, but unfortunately with the language barrier they probably didn't understand much more of our explanation than cats would. They got the idea that we came from out of the sky, but then they'd seen that for themselves. The idea of stars had to wait until we could point to them, but Sol was almost on the horizon by the time it got dark enough for that, so we weren't sure if they got which one we were talking about. It didn't matter; they were impressed no matter which particular light was ours. We bet none of the other travellers who'd stopped on their island had ever claimed to come from a star.

Our unusual physical properties lent credence to our claims. We certainly *looked* like we came from the stars. Opalescent white in sunlight, demonic red by firelight; and it didn't hurt that we were a head taller than most of the locals, either. Frankly, I was amazed at how well they were taking us; I didn't know many people back home who would be this friendly if something like us dropped into their midst.

They had a fermented fruit juice that tasted something like wine, and that made them even more friendly as the night wore on. We sang and danced and they told stories (which we recorded for the computer on the *Spook* to decipher when it learned their language), and when the hour grew late and they let the fire die down a bit, we made love.

That's just how casual they were about it. We were all nude already, and we'd gotten used to that, and as the night air grew cooler we all scooted in closer to the fire and to each other, so there was a lot of touching going on anyway, and pretty soon we noticed that people were kissing and fondling each other and the women were sitting on the men's laps—and then the women closest to us started rubbing our backs and nibbling playfully on our ears.

"I have died and gone to heaven," Liam murmured when Yavetra, the woman who had first touched palms with him after we'd landed, pressed against him and kissed him softly on the lips.

Another of our original friends, Etinitu, was wasting no time with Tilbey, either. His eyes grew wide as portholes when she reached for his not-so-private parts, then she tipped him backward off the log they'd been sharing.

A woman named Kylona had been rubbing my back, and when I saw what the others were doing with Tilbey and Liam I expected the same sort of thing. So I wasn't prepared for her to gasp and pull away, nor for everyone else to stop what they were doing and look at us.

"What's the matter?" I asked, but when I turned to look at Kylona I saw from her expression that nothing was wrong. She said something excitedly to the others, then rubbed my back again, even harder than she'd been doing. It felt great—the same muscle and nerve impulses that reacted when I was alive were still being transmitted to my mass-eliminator and interpreted in the same way as before—but by the cooing sound

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Kylona was making I could tell she was enjoying it just as much.

Nobody ever enjoys *giving* a backrub as much as getting one, do they? It was hard to imagine, but she certainly seemed enraptured. Some of the other women came closer and asked her something, and though I didn't understand the words I knew the question had to be, "What gives?"

She made them try it, and pretty soon they were all rubbing my back and sighing in delight. Yavetra and Etinitu had to try it on Liam and Tilbey, and sure enough, whatever Kylona had discovered worked for them, too.

I was pretty sure I knew what it was. Even at their maximum setting, our mass eliminators couldn't make us fully material. A determined person could still push through us, or in the case of these women giving us backrubs, they could push deep enough into our bodies to feel the electrical disruption effect we had on their own nerves. It must have tingled.

Even the guys had to get in on it, until by the time the entire camp had experimented on us, all three of us felt limp as noodles. Everyone else seemed excited, like they'd just discovered a new drug, and they seemed a bit disappointed when we called a stop to it, but they were good-natured about it. Kylona helped me stand up and led me off into the darkness to a mossy patch of ground beneath a sweet-scented flowering tree, where she made a bed of leaves for us and we lay down to sleep.

Well, not directly to sleep, but we eventually tired ourselves out enough to collapse in each other's arms.

In the morning we took our new girlfriends for a joyride in the lander. We only had three acceleration chairs, so they got to sit while we hung on to freefall handles and called out orders to the autopilot.

We should have used the magnetic grapples.

We'd risen to fifty kilometers or so, high enough that the surface was showing some curvature and thousands of islands peeked through the swirls of cloud. We were all oohing and aahing over the spectacle of it, the girls doing remarkably well with the unusual situation, when Liam asked, "What do you think, are they ready for free-fall?"

"Worth a try," I replied. "If not, we can turn around and go right back down under constant thrust."

"That's what I was thinking." So Liam told the autopilot, "Command, take us on up into orbit."

The 'pilot fired the main engine. I felt myself get heavy, felt my fingers start to slide through my hand hold, and realized I needed a better grip. "Command, stop thrust a second," I said.

I should have stayed quiet.

As it was, Tilbey slipped all the way through his handhold just as the engine died. The reaction from his weight-loaded muscles sent him careening into the air, at which moment the autopilot, taking me literally, counted out one second exactly and resumed thrust.

Dropping Tilbey straight down on top of the control panel.

His coupling constant was still set pretty high. If he'd just let himself hit and bounce off, nothing would have come of it. But a falling man doesn't think that way; he flailed his arms for balance and grabbed for the first thing he could reach. That happened to be the autopilot, and his pseudo-inertia drove his arm straight through the console and into its electronic guts.

We didn't get a spectacular shower of sparks. What we got was an instant jolt to the side, then an end-over-end tumble and a dying-gyroscope twist as random electrical shorts fired one attitude jet after another.

Five of us screamed. Liam cursed and leaped for the manual controls. Yavetra was in the center chair; he wrapped his left arm around her from behind to keep from flying away, and jabbed at

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the controls while she struggled to shake him off. After a few seconds the lander stopped tumbling and she realized what he was doing, so she let him finish. We stabilized into a nose-first ballistic arc. Tilbey pushed off from the wall where he'd wound up and grabbed his handhold again, this time with both hands.

"Command, one-half gee thrust into orbit," Liam said.

Nothing happened.

"Command, self-check, respond verbally."

Nothing. Tilbey had fried the autopilot. We could smell it now; the plastic and metal smell of burned integrated circuits.

"Excuse me, but I need that chair," Liam said. Yavetra didn't understand him, but she got the idea when he unbuckled her harness and gently lifted her out, then pushed her over to me. I oriented her feet toward the floor and showed her a handgrip. She knew something was wrong; her eyes were white all the way around and she was breathing hard, so I put one arm around her and said, "It's all right. We're a long way up, and Liam's a great pilot. He'll get us back down in one piece." The words were for me more than her, but I hoped a calm voice would soothe her fear.

Etinitu and Kylona clung to their chairs. All three women looked around the lander and out the windshield, their eyes darting every which way as they tried to see and understand what was going on.

Liam was running a manual systems check, querying each major subsystem one at a time with the touch pad and reading its response on the heads-up display. "How's it look?" I asked him.

"Do me a favor and toss Tilbey out the airlock," he said.

"Hey, it wasn't my fault," said Tilbey.

Liam glared at him. Half the burned-out circuitry on the *Spook* over the last five years had come from Tilbey's clumsiness.

"Well, it wasn't," Tilbey insisted.

"Just take us down," I told Liam. I wasn't interested in laying blame on anyone, maybe because I knew the lion's share of it was mine this time.

Then Liam said, "Take us down *where?*" and I quit worrying about that entirely. We had bigger problems than I thought.

The autopilot was the only memory device on board the lander that had known what island we'd taken off from. The women no doubt knew where it was in relation to the islands around it, but we were so far away from any place they'd ever been that they would be lucky to recognize which hemisphere it was in. And since it had been cloudy when we'd lifted off, they'd never seen it from above anyway. We'd seen it on our way down yesterday, and I did remember that it was sort of vaguely shaped like an egg with a wart on the narrow end, but it was over the horizon by now and probably still covered in cloud even if we could find the right general area, which I doubted we could do.

"We know what time it was," Tilbey said. "And we know the island was close to the equator. That should be enough to get us within visual range, shouldn't it?"

"Look down there," Liam said, nodding toward the windshield. Our ballistic trajectory had already arced over enough that we were pointed at the surface again. It was a flat, blue-and-white wall with rounded edges. "We're less than a hundred kilometers up. We can't even see an hour of time zone in either direction. How many islands do you see?"

It looked like thousands of them. Grains of pepper in a bowl of soup. There was no way we could find one particular island in that vast collection of them.

The women had been amazingly calm up to this point. I think they had been so far out of their element that

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they didn't know what to do, but there's something universal about three guys arguing over directions. We obviously didn't know where we were, so they decided to help us out.

Kylona, in the left hand chair, tapped Liam on the shoulder and said something in her language, then pointed out the windshield at the planet below us.

"I'm trying, hon," he said.

Etinitu and Yavetra both said the same thing that Kylona had said, only more insistently. They pointed again out the window.

"Maybe they know where it is after all," Tilbey said.

"Impossible." Liam looked out at all those islands and shook his head.

I said, "I don't know; they seem pretty insistent. I think it's worth a try."

Liam shrugged. "I guess there's not much to lose. I'll take us down as close as I can figure to where it ought to be and see if they recognize anything. Hang on." He looked at Tilbey. "I mean it."

"All right, all right, I'm hanging on!" Tilbey said.

I tightened my grip on both the grab handle and on Yavetra, and Liam flew us in. We swayed a little from side to side as air currents bounced us around, but Liam was a good pilot. In just a few minutes we were racing along over the surface at a distance of only ten kilometers or so. Cloud swirls drifted past, and islands played peekaboo through them, but it was clear that nobody recognized any of them. After a while Liam banked around and flew us along another line through them, then he turned and did it again.

The women had been speaking among themselves the whole time. Finally Kylona tapped Liam on the shoulder again and pointed downward.

"What, that one?" he asked. He slowed the lander and circled the island we had been approaching. "No, that one's long and skinny. Yours is more rounded." He made hand motions that would have been obscene if he hadn't been so serious.

Kylona shrugged. She pointed to that island, then to another one, then another, and said something short.

"I think she's saying, 'Who cares. Just set it down,'" I said. "I think they want to feel solid ground under their feet again."

Tilbey said, "Hmm, I don't know if that's a good idea. If we let them out, do you think they'll get back in?"

"I wouldn't," said Liam. "Not with you in here."

I looked from Yavetra, still snuggled up against me, to the other two. "You can't be thinking of keeping them prisoner."

"I'm thinking of keeping them from panicking and running away a thousand kilometers from home," said Tilbey.

"They don't seem the panicky type," I pointed out. If anything, they looked put out. I'd seen that look on women's faces before, and it wasn't a fond memory. "Let's just set down somewhere for a few minutes, collect our wits, and see if we can't figure out something better to do than just roar back and forth overhead. Nobody's going to abandon ship."

"So you think."

"So I think. You got a better idea?"

Tilbey looked out at the islands and ocean below. "No," he said at last.

The moment we set down on the pebbly beach, all three women headed for the airlock. We went outside with them, and I was relieved to see that they only walked off a little ways, then stood with their hands on their hips and scanned the forest.

Kylona cupped her hands to her mouth and shouted something that echoed off the trees, and a few seconds later an answering call came from off to our left. The women turned and jogged down the beach toward the source of it. Tilbey and Liam and I tried not to break our necks watching them.

"What do they think they're doing

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now?" Liam asked, just as half a dozen people came out from the forest farther on and jogged up to meet our passengers. They met in a friendly knot of hand-shaking and body-slapping (no solemn palm-to-palm gestures, I noted), then Kylona, Yavetra, and Etinitu began talking and pointing at us and at the sky.

The others burst out laughing.

"Oh great," Tilbey said. "You know who's the butt of this story."

"Tilbey, you're the ass in any story," Liam told him. "Get used to it." His voice carried an edge that made me uncomfortable. He usually wasn't this angry with Tilbey, especially when it really hadn't been Tilbey's fault.

When the natives quit laughing, a couple of them scratched their heads and pointed out to sea, but the others shook their heads and pointed farther up the shoreline. Another one pointed inland.

"I get it," I said. "They wanted to stop and ask directions."

"Fat lot of good that'll do," Liam said. He picked up a flat rock and sailed it into a wave. It didn't skip.

I turned to Tilbey. "Can you fix the autopilot?" He was our electronics expert; if something could be fixed, Tilbey could do it.

He just gave me a look that told me all I needed to know.

"Well, maybe we can—" I was going to say "hunt around some more and hope we get lucky" when there was a burst of laughter from the natives down the beach, then our girlfriends ran back toward us, laughing among themselves.

They spoke to us, then beckoned us back inside the lander.

"Did they really get directions?" I asked incredulously.

"Looks like," Liam said, abashed.

We followed them inside, strapped down and hung on, and Liam took us up. The women pointed the way, and he flew until they pointed downward again.

"This isn't it either," he told them, but when they insisted, he took the lander down. They ran out and called into the forest again, and repeated the same basic strategy they'd tried before. This time the natives all pointed the same direction.

We had to do it twice more before we found the island, but the women's technique of homing in on it worked beautifully. Stop and ask directions; who'd have thought?

When the lander finally settled down on the same stretch of sand that we'd started from that morning, Liam leaned back in the pilot's seat and let out a sigh that must have raised our air pressure by half a pound. He plucked the key from the control panel and tossed it up and down in his hand a time or two.

"I have half a mind to toss this sucker in the ocean," he said.

"You plan to flap back to the *Spook* when it's time to go?" Tilbey asked him.

Liam didn't say a word. He hefted the key once more, then stuck it back in its slot and we accompanied the women back to their camp.

We didn't see much of him for days after that. He would show up for breakfast and dinner, but the rest of his time he spent with Yavetra, learning the language and making love.

Tilbey and I didn't put as much effort into either pursuit, but we did learn to communicate both verbally and non. It took a couple of weeks to get good at it. Those were delightful, lazy weeks, spent playing on the beach, walking fern-lined paths through the forest, lounging in the shade on long afternoons with our girlfriends and talking about everything we could think of.

When we built up enough vocabulary to ask the question, we asked how these people had come to be there on Islandia when they didn't have any technology to get there from Earth, and they told us a legend of how a ship travelling the big night sea had taken their ancestors from another island—apparently

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ours—and brought them here many thousands of years ago. They seemed very matter-of-fact about it, as if population seeding happened all the time. Of course with as many islands as they had, it probably did—especially if they'd all been settled by migration from wherever the first colony had landed.

Their legend had to be pretty close to what happened. We had examined these people pretty intimately, and had yet to find a significant difference from the human norm. Except behaviorally. I had never in my life encountered people so open and friendly with strangers.

Liam felt it too. "I think I'm in love," he said one morning when he staggered into camp with Yavetra. We were all having trouble adapting to the twenty-hour day/night cycle, but that wasn't the reason he needed help walking.

Tilbey and I were helping our newfound friends peel dozens of tough-skinned yellow citrus fruits for breakfast. They were a new experience. I don't think we'd repeated a meal since we got there. We'd been starving for sensory input when we arrived; now I truly understood what people meant by the phrase, "an embarrassment of riches."

Tilbey laughed at Liam's bedraggled appearance. "'Coupling constant' is a technical term, not a suggestion," he said. He used the islander language where he could, except for the concepts we hadn't learned yet.

"It's not?" Liam asked in mock surprise.

Yavetra giggled. "Poor Liam never gets enough sleep."

"Thanks to you."

"He says it's because your world has a longer day, but if that were true I would think you would always be tired there, not here."

"You've got a point," I said. "But it works both ways. You'd be tired there; we're tired here." Actually, since we didn't have fatigue poisons building up in our muscles we just *thought* we were tired, but I didn't want to get into that. I didn't have the vocabulary for it yet even if I did. I just said, "It'll be less of a problem once we get used to it. Of course when we move on we'll have just as much trouble switching back."

Liam harrumphed, then said, "Well, yeah, that's something I wanted to talk with you guys about."

"What?"

"Moving on."

"You're ready to go already?" Tilbey asked.

Liam shook his head. "No. Just the opposite. I don't want to go anywhere. Ever again."

I stopped peeling fruit. "Ever's a pretty long time," I said. "I'm not in any big hurry to go anywhere either, but eventually we're going to want to check out some of the other islands. And who knows, in a couple of years we might even decide to head on into space again. See what we find around Epsilon Eridani or Sirius or whatever else is close. I'm kind of curious to see if there are people out there, too."

Liam picked up one of the round fruits from the pile at our feet and began peeling. "I'm happy right here," he said. "I've done plenty of exploration. I've done plenty of everything. I've sung in a rock band, hauled freight to Luna, flown fighters in Australia, been a janitor on a space station, and I've been an interstellar astronaut. Now I'm a welcome guest on the planet of Amazon Temptresses, and I somehow doubt that I'll be able to improve on this. Why would I want to move on?"

"Well, when you put it like that . . . " I said, wondering why I still did want to. I didn't push. You either felt the urge or you didn't, and there wasn't much use intellectualizing it.

Yavetra probably got every other word, but she was bright. She said, "There are more islands than you could ever visit in a lifetime. Every one of them is different. Even if you decide to explore, you need not go back to the

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cold, airless place you lived before."

Liam held out a wedge of the lemon-like fruit for her to eat. I'd tried a taste myself earlier, and it was actually quite sweet. Yavetra took the bite from Liam's fingers, her lips lingering there playfully for a second.

"What would you do with your mass eliminator?" Tilbey asked him. "It needs a lot of power to keep you solid like this. Without the *Spook's* fusion plant you'd be a vapor trail, if that."

"That can be fun, too," Yavetra said. I looked at her and Liam with surprise. They'd experimented with that, too? What was I thinking? Of course they had.

"We could put the mass eliminator in an instrument probe with solar panels and set it in heliocentric orbit," Liam said. "I couldn't stay cranked up all the time, but it would generate enough power for me to be solid for a few hours a day."

I supposed it would. I didn't think I'd like the limitation, but apparently Liam didn't think it would be a problem. He really *was* in love.

"And there's something else we haven't talked much about," he said, "but we're probably not the only people from Earth who are going to come calling. Now that they know the technology works, UNASA is going to send their own astronauts, and who knows what they'll do when they get here?"

We hadn't sent any message back to Earth yet since we'd discovered the natives on Islandia. Ours had been a somewhat hasty departure, made just minutes before UNASA's security forces would have impounded the ship in order to steal our experimental technology, so we didn't feel any great need to share our discoveries with them. But we *had* reported that we'd arrived in the Centauri system and discovered a habitable planet. We'd wanted to rub their noses in it back home, and we'd wanted to make sure the honor of being the first people to reach another star went to us. Now I realized maybe that was a mistake, since Liam was right: the UN space agency couldn't leave the accomplishment to us forever. Fuel requirements meant they couldn't send live colonists, thank goodness, but they could still do plenty of mischief with ghosts like us. Start religious missions, or some such idiocy. I didn't know what they would do, but I knew the people in the Solar System could never let people as free and happy as the Islandians live their lives in peace.

"Shit," I said in English.

Yavetra laughed. "I wish you would tell me what that means."

"It means we probably made a mistake," I told her. "We blew it, and you and your people could wind up paying the price."

"Oh." Her smile lost some of its usual wattage, and I felt like a total ass for spoiling her perfect existence. All of a sudden I wanted to go back out into space and catch up with our signal to Earth, send a message instead that said, "Nothing here after all, going on to someplace else."

Too late for that, but I understood at least some of Liam's motivation. This planet would attract missionaries and profiteers like stars attract comets. And since we had opened the floodgates, it fell upon us to defend paradise from the invaders.

Kylona approached our little group, already eating a handful of reddish berries for her breakfast. "What's the matter?" she asked when she saw our faces.

I told her, but instead of growing somber like I'd expected, she burst into laughter. "Oh," she said. "You're afraid of *lyshanti*. We've had plenty of experience with that."

"What's lyshanti?" I asked.

"Change brought on by visitors. Different ways of doing things, different foods, different attitudes. We're used to it. We enjoy it, sometimes. If we don't, we send the visitors away."

"What if they don't go?" Tilbey asked.

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"Then we eat them."

Tilbey actually shook his head, as if he might dislodge the bug that had made him mis-hear her.

"Did you, uh, say, uh . . . eat them?" he asked.

"Sure. No sense wasting all that meat." She bit into a berry and let the red juice dribble down her chin and between her breasts. "Mmm," she said. She was yanking our chains, sure, but from her attitude and from the way the others around us nodded, I suspected she was yanking them with the truth.

"Sure you want to stay?" I asked Liam, but I already knew the answer. I was at once repulsed and incredibly attracted to Kylona myself. I had kissed those red-stained lips, and despite what I'd just learned—hell, *because* of what I'd learned, and her devil-may-care attitude about it—I found that I wanted to kiss them again.

Liam shrugged. "So they eat their enemies. I bet it cuts down on the number of inconsiderate bastards around these parts."

"It does," said Yavetra. "I was a little girl the last time we ate anyone. He was tough and stringy, so we had to make soup."

"You'd have a hard time making soup with one of us," Tilbey told her. He thought about it a moment, and added, "And that's the problem. If somebody from Earth shows up with a load of nonsense and won't take no for an answer, you won't have much recourse."

"That's why I want to stay," Liam said. "I can get to and from space even if you take the lander with you. If somebody we don't like shows up, I can go up and trip their circuit breakers. Reprogram their navicomp and drop them into the sun. They can't keep me out, either."

"But they can do the same to you," Tilbey pointed out.

"They can try. I used to be a marine; I know a thing or two about fighting."

He probably did. Something inside me felt sad at the thought of Islandia needing a warrior to protect it from humanity, but if they did, then Liam would be the one to do it.

"Well," I said, "There's no need to decide right away, 'cause I sure don't plan to go anywhere for a while, unless of course we wear out our welcome." I looked to Kylona, and she grinned and fed me a berry. To Liam I said, "But if you decide to stay, I guess that's okay with me."

"Me too," Tilbey told him.

Liam laughed. "Good thing. Because I think if I had to spend another five years with you on a starship, I'd have to find a way to kill you once and for all." He said it with a smile, but I could hear how serious he was.

I looked at Tilbey again. He stood there, swaying just slightly off balance the way he always stood, an agent of chaos just waiting for another opportunity to trip over something and blow it up. Could *I* travel with him without killing him? The thought made me shudder. Not this soon after our last trip.

I looked up into the sky. Blue flecked with white puffs of cloud. I couldn't see beyond it, but I knew the stars were there, waiting for me to come investigate their mysteries. Islandia was nice, but I wasn't ready for retirement yet.

A vacation, though—that I could handle. A long, Sybaritic vacation among humanity's friendly, lusty . . . and busty relatives.

"Hey," I said to Kylona. "You and your friends want to learn to play volleyball today?" ■

(Editor's Note: This is a sequel to "Unfinished Business [October 1996], "The Spectral Stardrive" [November 1996], "Holiday Spirits" [January 1997], "Cease and Deceased" [October 1997], and "Why Didn't You Think of That Before We Left?" [March 1998].)

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F. Alexander Brejcha

WALTZING MY TILDE

A small object lesson for those who can't be bothered with small details . . .

It is such a little thing. A squiggly little line that invariably causes many a Spockian raised eyebrow when relaying a web address to resistant web-ophobes. "Tilde? What's that?" Or: "Where's that?" from those who at least realize you are talking about a written character.

Such an inoffensive little symbol.

Until you accidentally leave it out and almost start a war.

But I see confusion on your faces, Madam Chairperson and honorable members of the Senate. Perhaps I'd better backtrack a few days, to March 23, 2003: the day the aliens landed.

Hollywood did it much better, you know. The alien ship was a real disappointment. No enormous, musically humming and farting giant candelabra fit to grace a stage concert for the second coming of Liberace, and no kilometers-wide disks looming ominously over Earth's major cities. Just a squat and scuffed tin can the size of a large, round office building that looked right at home on the bleak Texas prairie as if a Bunyonesque prospector had kicked it there in disgust.

And as for the aliens, well, they were a bunch of dogs . . . and I mean that in a sympathetic way. They resembled a tired-looking lot of bipedal and emaciated six foot-tall greyhounds—and no, I'm not being redundant—who would have fit right in at the waiting room of a doctor specializing in eating disorders. As I watched them troupe off the ship I felt an almost irresistible urge to call an 800 number to offer up my credit card for a donation.

But at least I knew I'd have some work lined up. I remember turning to the president who looked ready to do some more dialing for dollars. . . .

"Are you ready, sir?"

He nodded, looking a little annoyed—probably because he would only be making a brief appearance before introducing the aliens to the U.N. Secretary General.

"Are you certain you can talk to them?" he asked.

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"Sure. I've been communicating with them for weeks, ever since they got to the orbit of Jupiter and we first heard from them. The transmission delay was useful at first since nobody expected an immediate answer, so we had time to work out a common language. It wasn't hard since they have been watching our television for some time, and they already know English and several other languages. But they insist on speaking for themselves, and since they can't form our speech, and vice versa, we came up with a compromise language. It's a little spare, but we've programmed both our computers to translate what we can't say verbally, so nobody will be offended."

"Yes, I hear they're a little touchy," the president grunted.

"Can you blame them? They've been traveling a long time, and now they come here and find out that we have pets and racing dogs that look related to them."

He frowned. "Well, I won't invite them over to the White House to play with Ethics. Still, it's a good thing our new dog is a poodle instead of a whippet." He eyed my computer. "And you'll be able to translate all right?"

"Just stick to the welcoming speech," I cautioned, "and go easy on the improvising, and we'll be fine." I had made the same comment to the Secretary General, and I hoped both would stick to it—and try not to think about the fact that every radio, television, and computer in the world would probably be listening and watching via cable, internet, network or satellite feed.

But we got through it fine, Madam Chairperson, each side keeping close to the well-rehearsed dog and pony . . . er, sideshow, exercise in diplomacy. In other words, not a genuine feeling or off-the-cuff remark made it on the air. But both sides managed to look very good, and with the best U.N. and White House spin doctors on the case, even the most critical media outlet would have been hard-pressed to find anything negative about the meeting.

And then it was time to get down to some serious negotiating with the security council. I had trained a number of other translators also, and like a good administrator, I was delegating and dividing the translating duties, hampered a bit by the fact that it would be a bit like the old game of telephone sometimes—with comments often going through two translators.

That's where I thought the trouble would come from. But I was wrong.

The negotiations went well. As you know, all the aliens really wanted was to resupply. An accident had destroyed their hydroponics farm for their livestock, and since our world—listed in the Galactic Handbook as a "here be there dragons" type of place—was known to be biologically compatible, the captain had decided to ignore regulations and stop by for supplies.

She had been stunned to find out that we were not going to throw nuclear bombs and laser beams in her direction, and as the negotiations for supplies concluded successfully—we got some neat gadgets to convert spent nuclear fuel and toxic wastes, as well as solar cells with an efficiency of at least ten times what we had—she had even cooperated with us to open a website for humans all over the world to learn about them and to communicate.

My translating team even got some fame, and we each got our own page under a translators' page, complete with a private message board, all under the main domain of http://www.celestial.alien.visitors.gov.

Unfortunately the webmaster assigned to the alien task force was not only rushed, but singularly unimaginative—and because of that, it wasn't entirely my fault that the Captain almost blew up Earth.

Really, it wasn't!

It all happened after the Security

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Council negotiations were all finished—three grueling and virtually non-stop days confined to an admittedly large room, but one with a partially malfunctioning ventilation system.

I see dawning comprehension on your faces—some of you must have met the aliens personally. It's not that I am inherently against dogs, but I'm an apartment dweller—it's all I can afford on my salary—and cats are so much neater. . . . Yes, Madam Chairperson, I'll get to the point. They smell. The aliens, I mean, not cats. A typically doggy—wet doggy—smell. And after several long days of close contact, I was getting sick of it.

But finally we finished, and dotted all the i's and crossed all the t's. And after I finished my report on the computer in my office, just like my compatriots were all doing, I logged onto the "messages" area to express my relief and to emphatically state that I was "heading to the shore for some fresh air that didn't reek of wet mutts . . . ". Yes Madam Chairperson, those were my exact words. And yes, I realize they were ill-chosen, but they were only meant for my own co-workers.

So why did I post it on the public message area of the aliens' web site?

Well, that's just it. I didn't think I was.

Do you know just how the web is structured, Madam Chairperson? Well for those who may not, allow me to explain what happened. The main address for the alien web site—it's called a URL for Uniform Resource Locator—is http://www.celestial.alien.visitors.gov.

Sounds awful complicated, but it really isn't once you get used to it. The "http" and the "www" are mostly standard, and the middle part is self-explanatory—they have to be a little unique now that there are so many web sites out there—and the "gov" is just because it's a government site.

Well, the webmaster—and like I said, he really ought to take some responsibility, ma'am—set up the main domain just fine, with a sublevel called "messages" for the world to post reactions to the aliens' visit. But he screwed up when he added the translator page called "translte".

Under "translte", he added all our individual pages, and also a private "messages" page only registered translators can access—but he gave it the same name as the public messages board: "messages" . . . And I see comprehension on some of your faces. You must have your own web sites.

But for the rest of you, let me explain that there is a shortcut you can take to prevent having to type every level on a web site. And that is the tilde I mentioned—it's at the upper left on a PC keyboard in the numbers row.

For instance, to get to my page, instead of typing http://www.celestial.alien.visitors.gov/translte/markovsky you just type http://www.celestial.alien.visitors.gov/~markovsky—the tilde bypasses a level—more than one if necessary. And I see you understand now.

I forgot to type in the tilde, and instead of typing http://www.celestial.alien.visitors.gov/~messages and rashly posting my comment, I typed http://www.celestial.alien.visitors.gov/messages. Such a little mistake, but instead of going to the private translators' messages page where no one else could read it, I went to the public messages page where the whole world—and the aliens—could read my indelicate words. I deleted my message almost as soon as I posted it, but it was too late since it was on the public message board.

Yes, Madam Chairperson, I'll wait outside.

"Mr. Markovsky, do you have a statement yet?"

The GNN news anchor was there personally, and his hand was first as I looked out over the sea of reporters waiting to hear my reaction to the Senate Investigating Committee's decision. I screwed on my most determined and enthusiastic smile as I needlessly adjusted

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the microphone and straightened my tie to face the assembly of television cameras and expectantly hunched reporters.

"The Visitors' captain has been most gracious in accepting my profound apology for the inappropriate words I mistakenly expressed in a public forum in a moment of utter exhaustion. You can ask more tomorrow night at the joint press conference which we will hold before the Presidential Ball at the White House."

I swallowed. "I want to add that I am honored to have been chosen as the Captain's escort for the evening, and you can ask her directly how she feels about the Committee's decision to put me in charge of personally supervising the loading of the supplies for the Visitors' ship."

Weeks of nonstop up-close personal contact and interaction with physically hard-working aliens. After an evening of ballroom waltzing with the alien captain.

That ought to teach me to type more carefully!■

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S.D. Howe

WRENCH AND CLAW

Perspective is a hard thing to get, whether in history or priorities. . . .

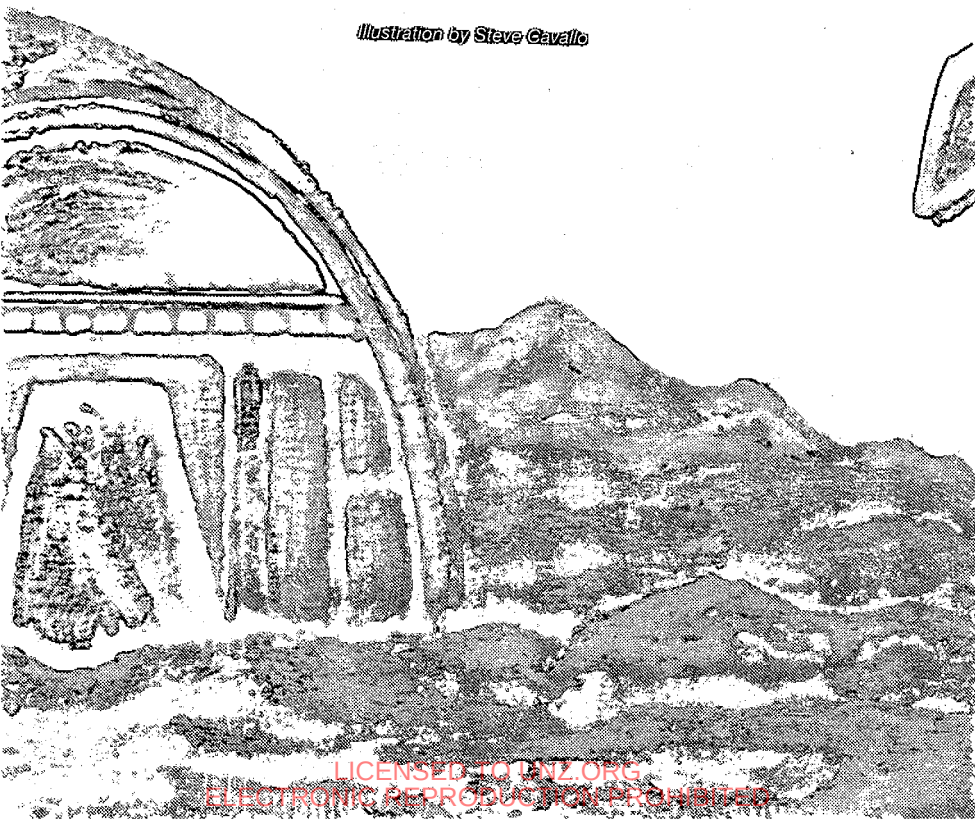

Illustration by Steve Cavallo

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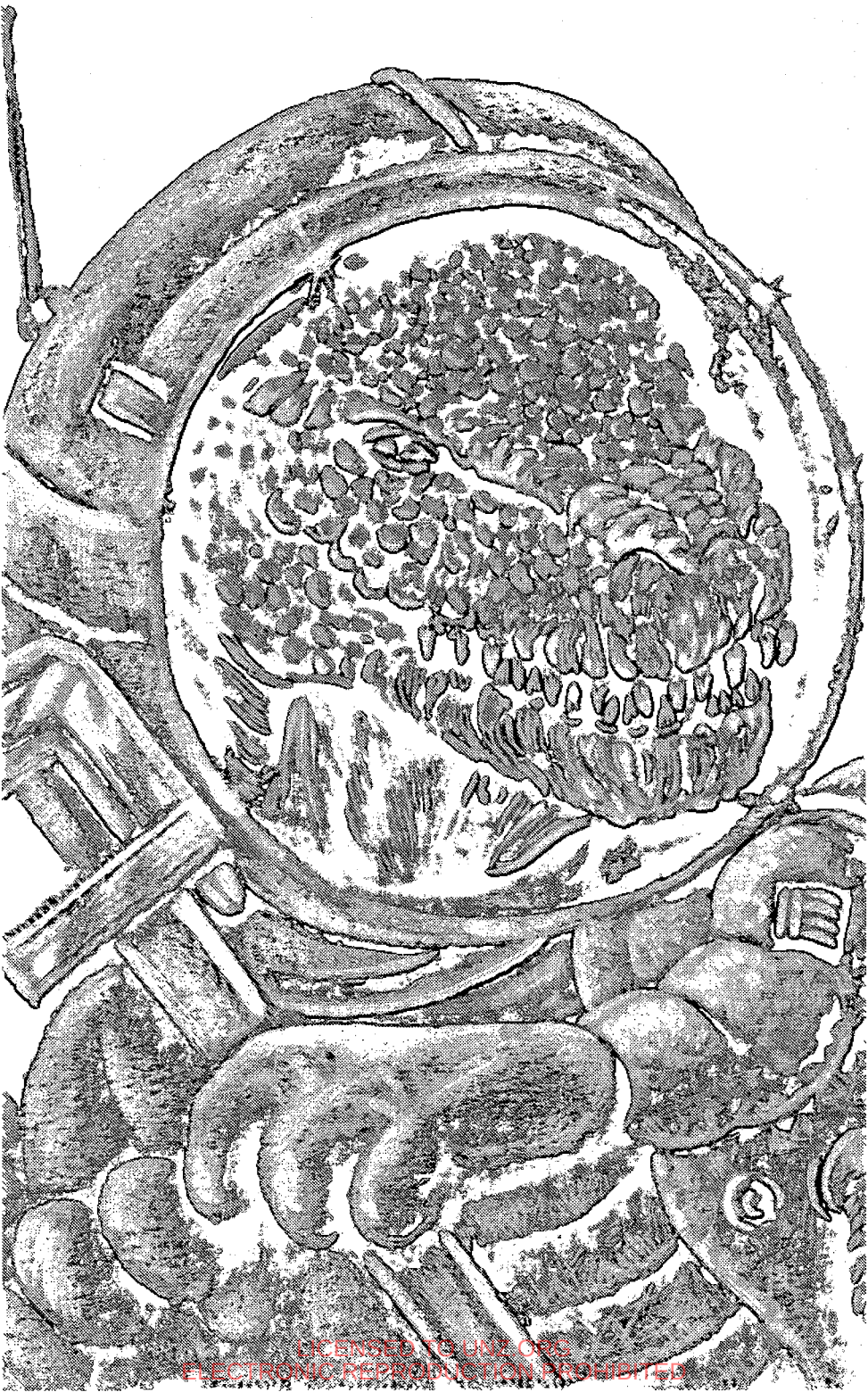

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PROLOGUE

Behold sayeth the King,
Is all lost already?
Blown away on the winds,
a desert,
to remain
until all memory
of the race
is
gone!

The last rays of the dying sun cast long shadows into the crevices where Bob was working. The loose, tan soil of the steep rocky embankment became tinged red by the light of the day's afterglow. Dust swirled in tiny twisting gasps. Another day gone by. Another day of painstaking picking and brushing; of trying to remove the dirt away from the bones lying imbedded in the rock for the last sixty-five million years.

Bob's back ached from being hunched over for hours. He was dirty, tired and irritated at the Museum back home for cutting the dig's funding. Still, the long slender forearm bone gleaming in the final gasp of the sun gave him a solid feeling of accomplishment, a job well done. Tomorrow he would begin cleaning around the claws that were already partly exposed.

The small glints of reflected light in the dirt near the claws caught his eye. Kind of a sparkle, like tiny lights seen from afar. Bending over, he chipped gently at the rock a few inches from the claw until a few small flakes fell loose. The rock was reddish in general, but only in patches. He'd often wondered about that. A few times before he had found these "zones" of reddish-brown coloration near his bony treasures. Looking more closely, he seemed to see tiny flecks of metal bits in the rock chips. *Very strange*, he thought to himself. *How could metal be there? Huh. Geology is strange and interesting, but not my problem. Oh well, time for supper.*

Bob tossed the rock chips into the twilight.

CHAPTER ONE

For a split second, out of the corner of his eye, Vesquith saw the rock grow white hot. Then it exploded.

Instinctively, he dove away into the loose dusty soil and waited for the ear-wracking blast to smash into him. It never came. Even though the explosion was only ten meters away, he never felt the wave of hot gas that should have hit him. Still, the somersault he executed might have saved his life. He couldn't afford to be hit by hot fragments out here.

Vesquith rolled up onto his feet, drew his gun, and looked behind him.

It was Gorak, of course. One-Thousand-Four-Hundred-Ninety-Eighth in the line of the Kanto and, ostensibly, Captain of the Seventy-Second Pack. Gorak was always one for a joke. He was also a real pain in the posterior vertebrae.

Vesquith took a deep breath, holstered his gun and choked down the verbal abrading that burned in his mind. Gorak was the younger of the two, but he was Pack leader. The chain of command had to be obeyed.

"Hah! Not too bad, Lieutenant Vesquith." The voice in Vesquith's ears sounded serious, but contained that subtle note of barely restrained laughter. "You jump well . . . good reflexes. Must come . . . from . . . dodging those big jump-snakes back home."

The voice burst into unbridled laughter. The figure curled over and pounded its knees. Suddenly, two more shapes came out from behind a large boulder, Tessaril and Salik. But from the hunch of their shoulders, noticeable even in space suits, they hadn't enjoyed the prank.

"Yeah, very funny, you guys. By the Great One, you could've holed my suit. Then what would you have done? We're four hundred kliks from base."

"Ah, come on, Vesquith, it was just a joke," said Gorak, waving off the criti-

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cism. "I was careful not to shoot anywhere near you. Besides, if you had gotten hit, the bus is right behind the hill. We'd have made it inside before you lost too much air—'less, of course, you panicked."

Although Vesquith couldn't see Gorak's face through the faceplate of the suit, he could hear the sneer surrounding those words.

"Well, what do you want, anyway?" he snapped.

"Hey, it's time to cash in. You've been out here all shift. Let's go eat."

Huh? Vesquith looked at his watch. It was time to quit. As usual, he'd lost track of the time. Even back home this often happened when he got involved in his work. But here on this airless, unchanging ball of dust he really had a problem. Here there was no time to lose track of.

"OK, let me just get my gear."

"Hurry it up," replied Gorak. "We'll be over at the bus."

Vesquith stood up and brushed the dust off his suit. Quickly he looked over the area to see if he'd forgotten anything. Bare ground, dust, and rock were all he saw. Grabbing his samples and tools, he bounded over to catch up with the group. Formally referred to as the Personnel and Equipment Transport, or PET, the big rectangular box on wheels could be called nothing but a bus. Vesquith dumped the day's samples in the racks mounted on the side of the bus and hopped towards the back end of the vehicle. He quickly entered and cycled through the personnel airlock. Crawling inside, he plopped down onto the long bench seat, cracked his suit, and lifted off the helmet.

"Sorry, guys, I got carried away."

Gorak signaled Salik, who gunned the engine and set the transport rolling.

"I'll never understand what's so fascinating out here," grumbled Gorak, shaking his head. "It's just a big, round rock covered in four inches of rock dust. How can you get carried away? What's to study?"

"Oh, no, it's much more than that," shot back Vesquith, caught by surprise. "There's a billion years of history written here. We can start to understand what happened to our own planet before life evolved. The Moon was ripped free out of the Earth about four and a quarter billion years ago. By looking at the mineralogy alone we can . . ." Vesquith realized everyone's eyes were beginning to glaze over. "A story told too often finds few ears to hear it," was what his grandpa had always said. Which was kinda funny since Grandpa told the same stories on every visit. But they had been good stories. Vesquith had realized weeks ago that the others weren't very interested in his long explanations. "Uh, anyway, there's plenty of stuff to learn out there. So, what did you guys do all day?"

Vesquith turned to Tessaril seated across from him. Each time he looked at her, even at the end of a workday, covered as she was in a bulky, dusty, rumpled space suit, his insides tingled. He couldn't help it. Her features were so delicate, so perfect. Totally incongruous with the course, bulky spacesuit of the corps. But Vesquith wouldn't even permit himself to fantasize about her. He was well below her station. Eventually, after her tour, she would be seeking a command officer as a mate. Someone with a long, well-established family line.

Still, she was so beautiful.

Gorak snorted up in the fore-cabin. "While you've been digging in the dust, we've been doing real work. The solar panels on the wide-field optical detectors had to be repaired and the electrical failsafe systems needed augmenting."

"Huh?" Vesquith puzzled. He looked across at Tessaril. Amazingly, she smiled at him and rolled her eyes upward.

She leaned over toward Vesquith. "We had to dust off the solar cells and check the batteries. Big deal."

The PET purred easily along the smooth surface. The low rumble of the treads sent a gentle, barely detectable

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vibration through the seat into Vesquith's suddenly fatigued body.

Sitting back into the seat, Vesquith looked up through the glass roof, now transparent during the lunar night. A bright, full Earth hung in the sky, beautiful, a deep crystal blue with giant swirls of brilliant white. The Earth was so bright that Salik didn't have to use the bus's running lights to navigate around the craters.

Vesquith could almost see the edges of all four great continents. At this time of day, tides twenty feet high would be racing inland. Clammers would be dashing toward the shore in their speed buggies at breakneck speeds to outrun the waves. Surprisingly, they rarely crashed or got caught by the huge curls of water that raced in each day.

The Earth looked so peaceful. People might be clamming or fishing or just strolling around at the end of the day. From here there was no indication of the tremendous turmoil underway at that very instant. No glint from the constellation of defense satellites orbiting the planet. No sign of the conflict and strife with the colony on the fourth planet. An alien robot probe passing by would see nothing. At this point it would not be able to detect the impending battles, the destruction, the titanic energies that were about to be released between the neighboring worlds.

And Vesquith had the perfect viewing spot to watch the end of civilization. The Lunar Observation Post was the ideal sentry position. From here they could detect radio traffic, ships under power, or even weapons being fired. They would give early warning to the Earth below. If the Mars fleet started to attack, the LOP would know it.

"How did we get ourselves into this mess?" Vesquith directed his question at no one in particular, just the air. "The first time any living creature gets off the Earth to colonize another planet and we have to end up in a fight which could destroy everyone. Why? Can't we just let the Martians alone?"

Tessaril's head jerked up. The question had obviously caught her by surprise.

"*We* aren't the problem," came Gorak's gruff reply from the front of the bus. "That idiot King Rornak the Supreme—he's the problem. Him and his nutso religion have corrupted the colony. That mud-slurper, he won't even let anyone call it Mars anymore. Now it's Rornakton or some such crap. Just because he can trace his ancestry back farther than most, he thinks he's a god. Now I hear he claims he's been given divine inspiration. Well, he'll be inspired once the new heavy dreadnoughts we're building are in orbit over his head. Once he's gone, the rest of the real colonists, not the fanatics, will rejoin with us."

As much as Vesquith hated to admit it, Gorak might be right, in this case. The Earth government could not allow the colony to become an independent state—especially with a religious fanatic as ruler. They had responded with a declaration of war. For the first time in known history, a war would be fought between two planets.

Still, he wished for some other path. Maybe the other colonists would kick the King out as they realized what was in store for them. Then things could settle down.

Vesquith looked out at the Moon's surface—shades of gray, bleak and craggy. This land had looked upon the Universe for over four billion years, almost as long as its mother, the Earth. Neither of them probably gave a whit what happened in the next few weeks. They'd still be there watching.

Life would go on.

Chapter Two

"Time.

"The concept of time has been the subject of many treatises from several perspectives for many centuries. I am not referring to time in the sense of a quantum-mechanical phenomenon or as

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a theoretical construct. Instead, I am concerned with the inability of the human mind to really understand what the passage of one hundred million years means, and why this inability impacts the way that science has viewed the capabilities of the Saurian species."

Bob had to admit, Dr. Dietlief was very adept at gaining people's attention. Not only was Dr. Dietlief a large individual—hell, he must weigh about two hundred and fifty pounds and stand about six-six—but the good Doctor had a wonderful, booming voice that simply resonated in the large room. Saurian species? He was obviously skilled at this type of engagement. Fundraising parties were probably his bread and butter. With his larger-than-life character and imposing stature, Dr. Heinreich Dietlief would provide exactly the type of excitement that the Denver Museum of Natural History was looking for. True, they also invited Bob, but he was sure he was just a token field paleontologist. Dr. Dietlief was the draw.

Bob looked around the room. The great hall of the Museum was actually the enclosed space between what had been two separate buildings. Elegantly crafted, four-foot-thick granite columns held up the ceiling three stories above. Balconies and hanging creatures of ages past looked down upon the hundred-fifty or so guests dressed expensively below.

Dietlief had waited rather quietly for the cluster of people near him to down their first drink, get some food, and exchange the usual, shallow conversations that routinely sprout at the beginning of a party. Now he was ready to hold court.

"According to current opinion," Dr. Dietlief began, "dinosaurs lived upon the Earth from about two-hundred-thirty million years ago to sixty-five million years ago. They existed in wide variety and ranged in size from chickens to giant behemoths larger than any land-based creature on Earth today. Although new revisionist thought has opened the possibility that some species were warm-blooded, highly sensoried, or perhaps, more birdlike than reptile in nature, the current view still holds that, at best, some groups may have been similar in mental capabilities to a wolf or jackal. That, taken as a group, intelligence was pretty low. *I* contend that over the one-hundred and sixty-five million year history of dinosaurs, entire groups of tool-using civilizations may have risen and faded to dust—that the interval of tens to hundreds of millions of years would have erased any such evidence! In essence, I propose that generalizing the abilities of the dinosaur from the sporadic fossil evidence currently available is a tremendous error and must be reconsidered. That, in fact, to assume that dinosaurs were big, slow, and dull-witted is a ludicrous, silly, and small-minded reflection of the pomposity of mankind."

Bob stood stunned.

"Well, that certainly gets your attention," said the woman standing next to him. Veronica Wells was the director of the Museum. Beautiful, statuesque, raven-haired, and voluptuous, she was also, quite frequently, the object of Bob's fantasies after weeks on a dig. Unfortunately, she'd always maintained their relationship at a clearly professional level.

Bob chuckled. "Yeah, not a bad opening line for a movie. I wonder what his point is going to be."

Veronica just smiled.

Dietlief slowly took a small sip from the glass in his hand. He clearly was letting the crowd adjust to his statement. Finally, after the buzz among the audience had died down, he continued.

"Essentially, the interested researcher must ask two questions: One—Why would we possibly even consider that dinosaurs might have been civilized? And Two—Where's the evidence? Why don't we find something like a crescent wrench clutched in a claw?"

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Bob caught himself and his toppling glass before he laughed out loud. A crescent wrench? The image of a six-foot-tall lizard in a greasy jump suit flashed into his mind.

"For the first question," Dietlief continued, "let us consider the only real data point available to us—mankind. From the known record, manlike creatures were around as far back as two million years ago. About forty thousand years ago, something happened which allowed mankind to gather into groups and become farmers—to work as a team. If, for the sake of argument, we assume that over the next ten thousand years humanity will either go to the stars, and thus leave the planet, or annihilate itself by war, then we can roughly argue that an entire tool-using species rose up from the morass of animals, created civilization, and departed within a span of fifty *thousand* years. But, the dinosaurs roamed the Earth for one-hundred and sixty-five *million* years!!"

Dietlief's fist pounded into his open palm. His gaze lanced out at the faces of those around him. His look dared anyone to question his sincerity.

"Thus, from the optimistic view," he continued, "there were *three thousand three hundred* opportunities for a dinosaur civilization to rise up and disappear into oblivion. Three thousand chances to pull themselves up from ignorance, build cities, fight wars, and die out. Is it possible that out of three thousand chances it occurred not once?

"But let's take a more pessimistic view, that the probability of achieving civilization is one event in two million years—in essence the interval that manlike creatures have existed on the planet. This assumption would indicate that eighty-two entirely different species could have risen, become civilized, and died during the saurian reign!"

So that was his point, thought Bob.

He chugged his drink.

* * *

CHAPTER THREE

The low hum of the ultrasonic dishwasher accented the delicate scent of hobak in Vesquith's mind. *Just like home*, he thought as he flopped belly-first onto his sleeping cushion. He remembered similar times during his boyhood. Father would be in the kitchen cleaning up, his brother would be working on the computer just as Gorak was now, and Mother, ruler of the household, would be reclining with a cup of hobak—real hobak grown on the southern tip of the southern continent, not this synthetic stuff Tessaril was drinking. Still, the Slow Time after dinner was often one of the most pleasant periods in a day. Even in an outpost bubble four hundred kliks from the main base, surrounded by vacuum, cold and radiation, Slow Time was a chance to bask in warmth, to think and to relax. The gentle breeze from the air recycler washed over his back with cool, delicate fingers.

There was one advantage to working out in the field at the outpost stations—they were new. The main base, of course, had some of the latest stuff, but it and the older research outposts tended to lack most of the new technologies. This outpost was the latest built and the most power-rich site yet. All the equipment was state of the art.

Outside, sitting quietly in the bottom of a small nearby crater, the new prototype power plant hummed away, providing all the electricity they could use. To an unknowing observer, the reactor was a silent box, about the size of an ordinary trash can, that did nothing. The two thick cables coming away from it were the only indication that it had some function. Using the new recoil-enhanced magneto-hydro-dynamic converter, the little nuclear reactor produced ten times more electricity than the previous thermionically converted systems. Not only did the reactor power the outpost, but it produced enough electricity to recharge the

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sulfur fuel-cells of the bus in just a few hours.

"I was surprised by your comment this afternoon."

Tessaril's voice shattered Vesquith's mood like a rock splashing into a serene pool of water. She rarely spoke to him directly, except to require something. Technically, they were equals with the same rank and privileges, but a female's privileges always seemed to be a bit greater than a male's.

Vesquith's heart pounded.

"Sorry, which comment?"

"Your perspective on the war. It was a bit unusual—for a male," Tessaril's eyes focused on Vesquith. She seemed genuinely interested.

"You mean that all males are supposed to want to fight, to dash into conflict for 'glory' and 'honor' regardless of cause or consequence?"

"Exactly," she replied, matter-of-factly.

"No matter who the enemy is—even ourselves," Vesquith tried to tone his voice to indicate just a hint of being insulted.

"Yes," was her only response.

"Well, I don't buy it. It makes no sense. If everyone expected such behavior—if we are so predictable—why did we colonize the fourth planet? The logical conclusion of colonization would be that eventually the colonists would break away, and we would find ourselves in a war of worlds for glory and honor. The idea of colonization, I thought, was to end the wars by fighting against the challenges of space—of conquering new land."

"As so many of us also believed. That's why so many more females were sent in the colony team, to ensure a stable, peaceful community. Evidently, the government underestimated the size of the Destinist Movement."

"That cult?" Vesquith asked. "You agree with Gorak, then, that the religious fanatics have taken over?"

"What was *thought* a cult. From what I've read, the Destinists had a much bigger secret organization. Although I can't understand why a self-respecting woman would adopt such a sexist philosophy. But supposedly," Tessaril snorted in disgust at the thought, "they implanted most of their congregation into the colony team. Once the habitats were established and self-sustaining, they took over control. Now they are the new Order of Rornak."

"But he's a nut. He thinks that men should rule the household and women should only nest and support the men. He even advocates multiple mates for each male instead of the ritual Fights! It's disgusting." Vesquith's voice rose a notch. He wasn't sure he could discuss such perverted sexual mores with Tessaril. He didn't want to offend her.

"Exactly why no one thought the Destinists were anything but a youthful fad. We were wrong. Now we face war."

"Maybe not." Vesquith's optimism filled his voice. "Let Rornak have the planet. It's short on heavy metals and only the equatorial band has any water. From what I understand, the water has been migrating to the polar caps for the past ten thousand years. Eventually, the planet will be a dry, dusty, lifeless ball. It can't sustain a large population. Thus, it can't be a real threat."

"Maybe not, as you say, but I think you underestimate their fervor. The news yesterday reported that astronomers had detected a new asteroid—possibly a carbonaceous chondrite, ten miles across."

"So?"

"Observations at the LOP show it is being powered by nuclear explosions. Calculations show it will reach Mars orbit in three months. If it has a ten percent concentration, it holds probably a trillion tons of water, let alone other minerals."

Vesquith sat stunned. They were seeding Mars! They could add another moon in orbit to join the one satellite already there. Water would be mined at their leisure. Or they might crash the thing

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down and flood the Martian surface with rivers of water. It was brilliant. An asteroid was the perfect object to be moved by sequencing small nuclear explosions. But . . . !

"But that means they have an arsenal of nuclear weapons!" Vesquith blurted.

"Exactly. I don't know if they got the money to buy them, or found uranium deposits, or what. But if they have enough devices to move rocks in space, they have enough to bomb the Earth."

"But that would be nuts. They'd leave the planet totally uninhabitable. They couldn't return if they wanted to. Nobody would nuke the whole planet!"

"Who knows? These people don't follow our logic," said Tessaril. "The High Council of Clan Matriarchs is meeting now to discuss possible solutions. The real problem is that we can't get much information from Mars. We don't know how desperate they are—or how crazy."

"So we may have to strike first, huh?"

"Maybe."

"Still, it all seems very tragic, or maybe ironic, in a cosmic sort of way. Earth finally raised children able to leave the nest, and they turn around and attack her. I guess that's evolution in action, huh?"

Tessaril's head jerked up and cocked sideways to look at Vesquith. She had a look of serious interest but also slight puzzlement. Her nostrils flared slightly. Vesquith suddenly found himself very self-conscious under the scrutiny.

"You are an unusual man, Vesquith, Three Hundred and Forty-Eight in the line of Tassergil. You have a refreshing viewpoint. We'll have to talk of this some more."

Vesquith's heart skipped several beats. His eyes widened and his feet curled. The breeze on his back was suddenly wholly insufficient for cooling the flaps on his back. Slowly they extended. He hoped she didn't notice.

Possibly, just possibly, there were other advantages to working in the research outposts.

Chapter Four

"I would like . . ." A raised hand from Tessaril cut Vesquith short. Following her gaze toward Gorak, he became aware of the news broadcast.

"The word from our exclusive sources is that the High Council has issued an ultimatum to Governor Rornak to step down or face significant measures. This reporter can only assume that this means massive military action. In a communiqué released by self-proclaimed 'King' Rornak's office, the leader stated that, 'We will fight to the death, nay, to the end of our Lines, against oppression. We have chosen our own way. Though we are outnumbered and outgunned, we shall prevail, for Destiny is with us!'"

"Standing here with me now is the Deputy Assistant to the Clerk of the Undersecretary of the Diplomatic Mission to the Mars Colony, Seven Hundred and Sixty Eighth in her Line, the Honorable . . ."

Gorak switched off the viewer.

"Hot damn, those stupid perverts are in for it now! We're gonna kick some tail for sure."

"Don't be so sure," said Vesquith. "If they've got nukes we could be in for a nasty war."

"Ah, that's a load of honker-hocky. Soon we'll have a whole fleet parked in Earth orbit ready to go pound 'em. They've got-what? Twenty ships and a few bombs. They can't surprise us—that's what *we're* up here for. The gear up here can see their butts wiggle. Anything they do, we'll know about in plenty of time. I just hope they try to land a group here to take us out. Then we'll have some fun!"

Though not desiring war, Vesquith found the idea of a hand-to-hand fight exciting. The image in his mind of an invading Pack made his muscles twitch. His back arched involuntarily. Millions of years of evolution had built him for it. Even though he saw the war as illogical with his conscious mind, he would be ready for a good fight if attacked.

"If it must be so, it will be a good way

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to go," Vesquith said resignedly. "We aren't very well staffed, though, only thirty of us."

"Aha," snipped Gorak. "You've not been keeping up. We're expecting a battalion of Amphibious Marines as a surprise! If those Martian bastards come here, they won't be goin' home."

Vesquith was shocked. AMs? They were the best of the best—career soldiers—professionals. They'd spent their whole lives developing war-fighting skills. They'd been bred and raised for strength and speed. The AMs were supermen compared to Vesquith and the other base regulars, most of whom were scientists who had been drafted into service. A battalion of AMs would be unbeatable.

Then another thought crept into Vesquith's mind. A battalion of AMs would not be dispatched lightly. They would only be sent as a prelude to a major offensive. Troops like that would be commanded by seasoned officers—officers of stature, family and power.

Vesquith glanced slowly over at Tessaril.

His short-lived fantasy of catching her attention would obviously be shorter-lived than even he had expected.

Chapter Five

"OK, I'll grant that you've made a good argument for the statistical possibility of a civilization, but how could they have built cities when they had a brain the size of a walnut?" Bob demanded.

"That question presupposes two questionable assumptions," responded Dr. Dietlief. "One is that we've discovered samples of all of the dinosaur species that ever roamed the planet. The other is that the brain-size-to-body-mass ratio is an indication of intellectual capability."

Dietlief paused at this point to grab a stuffed mushroom from a passing waitress and to let his assertion sink into his audience.

"Would you admit that the fossil record is incomplete . . . that large gaps of millions of years exist in which we have found no fossils at all?" Dietlief pointed straight at Bob, his napkin dangled from his beefy fist.

"Well, yeah . . . sure," Bob answered. "We haven't covered enough . . ."

"Exactly," snapped the big man. His voice boomed out among the crowd. "Certainly, we've found thousands of fossils over the hundred years or so that the science of paleontology has existed. In order for these data to preclude a civilization, though, we need to find dozens of species in each fifty-thousand-year interval, or at minimum in every million-year interval. Perhaps large-brained dinosaurs did exist and we simply haven't found their remains yet. Hell, the fossilized vertebrae of the longest dinosaur that ever lived, Seismosaurus, were found only fifteen years ago in New Mexico, and he was a huge sucker."

"But surely we would have found something by now, some kind of evidence," interjected a serious-looking, expensively dressed woman in the group.

"Well, let's look at that a moment, Mrs. Goldberg," grinned the Doctor. "Not only are there large gaps in time where we have found no fossils, but there are very large areas of the Earth's surface where we have found nothing also.

"Let's say that you're a saurian auto mechanic somewhere around the year one-hundred-million B.C. living near a seacoast village. You're working on your car by the stream that runs past your home to the sea. The jack fails, the car falls on you and your crushed form slides with the car into the stream. For one reason or another your body is left at the bottom and over the next one-hundred-thousand years you become fossilized, still clutching the torque wrench in your claws."

A light twitter ran through the great

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hall as the listeners imagined the scene unfolding. Almost the entire crowd now hung on the words of the large man.

"Now," he continued, "over the next twenty million years, your piece of real estate gets buried, heated, and pressurized to make a good sedimentary rock a few thousand feet below the surface. Over the next thirty million years, your plot is shuffled around, cracked up, and eventually starts to be pushed up to the surface.

"Oh, I see," interjected Mrs. Goldberg. "What's the chance that the scientists would find his little plot of land? He might be lying just beneath us right now."

"Exactly," boomed Dietlief.

"Oh, how exciting," bubbled the woman.

"So now we, the current residents, have to ask ourselves the following questions." Dietlief held up his left hand with the little finger extended. "One: How much of the surface of each million-year interval is exposed for us to find versus being buried inaccessibly deep in the ground? Two: What is the probability that the pieces of old Earth that are now exposed happened to have a dinosaur fall there with suitable conditions for fossilization? Three: What is the probability that if the mechanic and his wrench were exposed on the surface, they would be in such a place that erosion wouldn't have destroyed them before discovery? Four: What is the probability of finding and recognizing the mechanic? and Five: How much did he charge for a brake job?"

Dead silence hung for a moment. Then the crowd burst into relaxed laughter. Dietlief smiled and used the pause to grab another passing morsel as the buzz of conversation filled the room.

After a suitable pause, he continued. "The intuitive, qualitative answer to each of these questions is—small chance. Thus, the chance that all are simultaneously true is . . . damned small. To think of it another way, we have no idea how many species or individuals for which we have found no evidence have actually walked on this planet. We only know that the ones for which we've found the bones, did."

Dietlief scanned the crowd around him like a great bear guarding a newly killed elk. He looked pleased. He was working the crowd well.

Bob didn't like it.

This kind of pseudo-science, gobbledygook, hocus-pocus was fine for children's stories, but led the uninformed public to expect wild discoveries. These ideas were sheer fantasy.

"Could we get back to the earlier question of brain-size-to-body-mass-ratio?" Bob jumped in. "Surely a brain must have a size threshold or minimum neuron density to control large bodies."

Dietlief's gaze paused and settled onto Bob. His large bright smile gleamed for the crowd but the tips of his mouth dropped just slightly. Dietlief didn't like the interruption—or the implications.

"Good, young man, thanks for keeping me on track."

Bob felt his face redden. He wasn't a boy to be patted on the back of the head and shuffled off to the side. He suspected that Dietlief knew who he was and was purposefully trying to belittle him. Bob started to interject a reply but was overwhelmed by Dietlief's booming voice.

"Let's go back to the second assumption about brain size. This assumption is both presumptuous and anthropomorphic. One, a true correlation of brain mass to intelligence in mammals called humans has not been proven. Previous investigations have been shown to be in error. The debate continues to rage between camps arguing over racial and environmental differences. So far, no definitive conclusions have been reached."

"Fine," said Bob, pointing at Dietlief's chest, "so no correlation exists. But there must be a threshhold of brain mass—a minimum size to support the body. To that the mammalian record is pretty clear."

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"But the point is that it wouldn't matter anyway," Dietlief shot back. "Dinosaurs were not mammalian, so any correlation of mammalian nervous reactions to saurian is totally invalid. After all, the saurians developed creatures who lived on land that were far larger by several factors than anything that has ever existed in the mammalian world. According to your mammalian metabolism and musculature, dinosaurs this big could not eat enough each day to live and would be essentially nonfunctional. Yet we now have evidence that these giant beasts roamed freely over huge ranges. Obviously, the dinosaurs were different."

"Granted, they were different. We don't yet understand how they could have grown to such huge sizes. But that doesn't relax the need for larger brains."

"But the condition that allowed the large sizes may have also allowed for smaller brains," Dietlief bellowed. "Maybe the air was different then. Maybe it had a higher concentration of oxygen that enabled a more efficient metabolism. Why could this not also apply to mental capability? Perhaps their brains and nervous systems were more efficient or were "wired" differently than ours. Consequently, they may not have required so large a brain mass. And again, perhaps there were larger-brained species that we just haven't found yet.

"Saurians were sufficiently different physiologically so as to be unknowable. Just because they came earlier than us, doesn't mean they were a less advanced model!"

Chapter Six

Ruins.

The entire damned base lay in ruins.

Vesquith stood in abject disbelief. How could this happen? Where were the base personnel—and the AMs? If what Gorak had said was true, there were over two hundred soldiers staged here on the way to Mars. How could such an army of trained, disciplined soldiers be overrun so thoroughly in a few days? He'd only been out a week.

And where was the enemy? Had they overrun the base and then run back to some secret outpost? Or had they gone back to space? Would they be back?

Vesquith stood in stunned silence. All around him lay rubble and destruction. The place looked like some of those new micronukes had been used—detonated from inside the room. Sabotage? A secret insider?

No. The radiation levels were normal. No indication of fission products. Even a fusion-only device would have produced enough neutrons to make some longer-lived, gamma-ray-emitting isotopes. No, this must have been done with conventional explosives.

Then where were the blast marks? In most places, it appeared that the entire ceiling had caved in and buried everything.

"Tessaril, Salik, you find anybody?" Vesquith hoped the others had found the Marines in another part of the base. Perhaps they'd been trapped in one of the many tunnels.

"No, no one." The answer came from Tessaril with a tone of finality like a judge's gavel imparting a death sentence. "There are some areas we can't get into 'cause of the cave-ins, but we get no indication of any activity anywhere at all."

"Gorak is going nuts looking," interrupted Salik. "I saw him scurry by and head toward the galley."

"Maybe we ought to regroup and decide on our options," said Vesquith. "Any suggestions as to where?"

"From what I've seen," Tessaril came back, "most of the damage seems to be centered around the control section and the dorm quarters. Maybe the motor pool will have some salvageable stuff."

"Good idea," said Vesquith. "I'll check the infirmary first and see if there's anything usable there. I'll see you in the pool in about twenty minutes."

"Gotcha." Tessaril's voice sounded

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concerned but not panicked. "I'll go by the power station first."

"Sounds good to me," said Salik. "I'll go after Gorak and look for anything edible. See you in twenty."

Vesquith started working his way through the rubble and junk that filled the room. Everywhere were wires and pipes hanging down intermixed with chunks of rock. Occasionally, he came across a hand or some other appendage jutting out of the rubble.

They had known something was wrong just after rounding the crater's edge. Instead of the bright, well-lit windows of the base's rec room set into the wall of the crater, they had seen only darkness. Directly above the place where the great windows should have been, the crater wall was dented . . . sunken.

Instead of going straight over to the motor pool hangar, the group had stopped in silence in front of the great window, now broken and shattered, looking like a gap-toothed skull set into the side of a mountain.

Gorak had leaped out of the transport without a word and plunged through the window openings into the dark recesses beyond. The rest of them had fanned out to assess the extent of the damage and look for enemy soldiers. For the past thirty minutes they had looked for survivors. They had found none.

Kargill, Skalario—all his other podmates. Everyone was dead. He'd gone through basic training with them. They'd lived in the wilderness for three weeks together, caught one of the giant sharks in the central ocean basin, seen the Triple Volcanoes of the Great Rift. He'd met their Line Fathers. They'd been his friends. Now they were silence filling the seam between massive stones. Damn! Damn! Damn!

And Telisa—cute, stubborn, little Telisa. Vesquith had stood second to his brother, Vordoc, in the Nesting Fight for Telisa. How would he tell his brother that she was gone to the Great One, that he hadn't been able to find even a remnant of her body to bury in the Family Fields?

Vesquith stumbled down the corridor pounding his gloved fist against the wall. Finally he reached the infirmary—or rather, the door to the infirmary. Actually, the door was gone. In its place was the edge of a stone slab at least as thick as the height of the door. Evidently, the larger expanse of the infirmary's ceiling had given way. Everything and everyone inside must have been crushed in an instant.

Amazingly, though, the curved roof of the tunnel ceiling was predominantly intact. Only small chunks of stone had been knocked loose in random places. But the tunnels had been melted into the rock using a nuclear-heated probe. The lining of the tunnels was evidently strong enough to withstand whatever had blasted the base.

Vesquith took a few steps farther down the tunnel. Then he saw the bodies. At least a dozen figures were piled up in the tunnel. The nearest were in various stages of getting space suits on. The ones behind were crawling over the nearer ones. From the look of it, each had fought to live, but in the end all had died when the base depressurized. The dim light from Vesquith's helmet cast eerie shadows among the corpses, accentuating the grimaces of frustration and anguish that were frozen for eternity.

Vesquith forced himself to rummage through the stack of limp forms. Unfortunately, they had opened all their oxygen cylinders, even the spares. He could imagine their vain attempts to gasp a few more breaths before succumbing to the relentless grip of pure vacuum. Now the tanks were useless.

Vesquith bowed his head in respect, turned and left them in the darkness.

"Tessaril, this is Vesquith. I came up empty. Am heading toward the MP."

Minutes later he walked into the large cavern. This had been the original site of

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the base when it was first established. An immense natural lava tube, it had provided plenty of room and protection after the front opening had been sealed shut. After the command and control had been built into the nearby crater wall, the large expanse of the tube had been perfect for the motor pool.

Vesquith stood in the entrance. The wall beside him had caved in, but not too badly. He was surprised. These walls had stood inviolate for hundreds of millions of years. *What the hell did they hit us with?!* echoed faintly in his mind.

The other three were against the far wall. Gorak sat on the floor holding his head in his hands. Salik and Tessaril stood back to back nearby. They were quite clearly in a confidential conversation. He could barely make out the telltale blinking of the Short-Range Optical Communication Emitters, mounted on the backs of their helmets. The SROCE units were usually used in combat to talk to each other while facing outward. Evidently these two didn't want Gorak to hear whatever they were talking about.

Vesquith approached to a respectful distance and stopped. Tessaril acknowledged his presence with a slight wave of her hand. Momentarily the pair broke apart, having finished their discussion.

"So what have we got?" asked Vesquith.

"In short, not very much," replied Salik. "I found a week's worth of dehydrated veggie packs and about ten liters of water. Everything else edible was burned or buried. I also found some of the marines. Most of what I could see had made it out into the tunnels. But the tunnels in the barracks section had partially collapsed. I found no survivors."

Salik's voice quivered noticeably. He, too, had lost his pod.

"What about power?" Vesquith turned to Tessaril.

"Well, the generator doesn't look too bad. The fusion reactor evidently scrammed quickly and was protected by the fused rock radiation shield. The helium-three tanks are nearly full so we can restart the reactors. We've got plenty of electricity but no transmission lines and nothing else to use it for."

"The lights are on, but nobody's home." A gurgled laugh accompanied the words. Gorak stood up shakily.

"What?" asked Vesquith.

"Don't you get it? The lights are on and nobody's home! It's a great cosmic joke! Sanaroc the Protector has pulled a funny! He left us alive but with no hope, just like the herdbeasts he protects. He's showing us what it's like to be the victim. Am I the only one who sees it?"

The other three stood silently for a moment, staring at their colleague. Finally, Vesquith put a hand out to Gorak's shoulder.

"Yes, we get it. But right now we've got to figure out how to survive."

"Survive? For what? How? We don't have a chance."

"Why don't you sit back down and rest a minute, OK? Maybe we'll think up something."

Gorak angrily struck the consoling arm aside.

"Fur-brain! There's nothing to think about. We're dead meat, roadkill, fish bait! At least these guys died fast. We either die of thirst, hunger, asphyxiation, or freezing. Choice of the Trapped, huh?"

"Calm down, Gorak," said Vesquith quietly. "Let's look at our options first."

"What options? We've got exactly none! You guys stay here and think yourselves pink. I'm goin' out to find the furry sons-of-fishes that did this and kick some tail!"

"Wait, don't . . ." Vesquith blurted.

Gorak sidestepped the reaching hand and dashed across the large room into the darkness of the tunnels.

Vesquith turned to run after him.

"Vesquith, stop! Let him go." Tessaril's hand on Vesquith's arm was enough to stop him. "Let him go cool down. We'll

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pick him up later. Right now we need an idea."

Vesquith turned to look at her. Tessaril's voice was calm and in control, but even through the suit's visor he could sense the fear she felt. She was terrified of dying a slow, lonely death on this barren, ignominious little world. Only her will and intense discipline kept that terror at bay. She was a caged animal, barely under control. He needed to think of something to strengthen that cage.

"Look, both of you, we're going to get through this. We aren't helpless, but we are short on time. Our first need will be an oxygen supply." Vesquith tried to put the right blend of forcefulness and enthusiasm into his voice. He'd mourn the loss of his friends later. Even if *he* didn't feel they had much of a chance, he wanted the other two to have hope. "We've got the bus to live in if we can keep it pressurized. We'll at least have more time to think. Salik, can you see any way to make enough oxygen for the four of us?"

"Huh . . . well, yeah, maybe. But why? So we can breathe? It'll only postpone our deaths longer. We've got no heat. We'll still die. Let's just go make peace with the Great King and accept our fate."

"No!" snapped Vesquith. "We aren't snorkel beasts! We don't lie down and bellow our deaths at the first sign of attack. We fight, damn it! We won't quit!"

Vesquith grabbed Salik and shook him.

"But what can we do?" Salik asked pitifully.

"Look," said Vesquith, "Tessaril says we've got all the power we want. Some way we'll rig some heaters. But we need to breathe first. Maybe one of the subsurface water tanks is intact. That's the source of oxygen. If we can stabilize our survival problem then we can try to get some communication back to Earth. If they know we're alive, they can send up a supply ship pronto. Then we'll be OK. Right now, though, we've got only a few hours left to get the oh-two source fixed up. Can you do something in that time?"

The look in Salik's eyes changed. Vesquith could see the ideas start to flash, connections begin to link, hope start to reawaken.

"Maybe," came the slow reply. "Just maybe. We've got some of those titanium support rods from the antenna setup left over and we can get some spare tanks from the marines. If I can get a compressor from somewhere. . . . But I'll need help. Let's go look at the generator."

As the three started toward the tunnel back into the base, Tessaril's gentle touch caused Vesquith to lag back slightly. As he dropped into step beside her, she tapped the side of her helmet indicating the SROCE.

Vesquith keyed the unit.

"Yes?"

"You know it's pointless in the end," said Tessaril. "We've been taken out for a reason—so the Earth forces can't be moved. The Destinists must be fighting for control of near-Earth space. Our people won't have the time, capability, or the reason to try to get a supply ship up to us. We're on our own, at least for a few weeks. Even if Salik is successful, we can't make it."

"Why not? We've got more than enough power to make what we need. It'll just take some work and improvisation. We can do it."

Tessaril reached over and gently clasped Vesquith's forearm.

"Vesquith, it is good to have purpose. I agree with what you've done, especially for Salik. But we must also be realistic. We have no food for four of us. Even if we all deep-sleep, we can only hold out for seven days. What can we eat?"

Vesquith thought furiously. Now more than ever he wanted to live, to keep the new respect in her face, to save Tessaril.

"We'll do what we can. Maybe we'll find something in the end, though, if necessary, it may not be *what* we eat, but *who*."

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Chapter Seven

"All right, all right!" Bob had had enough. Entertaining as it was, it was false and needed to be exposed. Dietlief had paused to let the crowd break up and talk among themselves. Everyone seemed to be giving the incredible story serious consideration. "You've got some interesting points. But they all pertain to the discovery of remnants of dinosaur bodies. If a large civilization existed, wouldn't we find evidence of the city? Something should remain—a hammer, a ceramic pot, or a Big Mac carton—something."

Dietlief stopped talking to the richly dressed woman beside him. He gave Bob a look like one would give a pesky fly. The crowd moved in closer, sensing the tension between the two men.

"Well, OK, let's get down to the real crux of the problem," said Dietlief. "Why haven't we found any evidence, assuming that such civilizations might have existed? It's here that we must begin to understand time and just how long ago these creatures lorded over the Earth."

"Nice words," snorted Bob, "but they didn't *lord* over anything. They were animals."

"Maybe . . . maybe not," huffed Dietlief. "So, again, let's start by looking at human achievements. The Egyptian civilization reigned in one form or another from three thousand B.C. to about zero B.C. Based on the observed erosion rate of the pyramids, those massive lumps of stone may last another five, ten, or even twenty thousand years before withering down to an unrecognizable lump. Who knows, perhaps that was the intention. Maybe the real treasure tomb is totally sealed inside and will be revealed and accessible only after ten thousand years. That would seem to fit the Egyptian desire for immortality, huh?"

Bob was nonplussed. "So what's your point?"

"The point is that the last dinosaur supposedly lived *sixty-five million* years ago! That's three thousand, two hundred and fifty times as long! Just try to imagine how long that is. The oldest human relic may be ten to twenty thousand years old. Think what a hundred thousand years would be. Ten times that is only one million. Sixty-five times that is the last dinosaur!

"In that time scale, even inert metals such as steel will eventually corrode to dust. The steel wrench in the dinosaur mechanic's claw will be exposed to water, ionic replacement, heat, tremendous pressure, and weathering. Pottery will be shattered and pulverized. Metals will be corroded. Plastics, even Styrofoam, will have broken down long before. No artificially made object could withstand the ordeal of sixty-five million years and retain its identity!"

"But we'd find the imprint," insisted Bob.

"What if the original item had not been removed but had just been replaced chemically? What if concentrations of iron or other metals were present as discolorations near a fossil's location—a spot of reddish rock here or there? What paleontologist would recognize the potential, test the spot for elements, and suggest a saurian-made tool as the source of the spot? None, nada, nichts—I can assure you!"

"Oh, come on, that's too simplistic," said Bob shaking his head. "If we found something really out of the ordinary, we'd investigate." He paused. Something nagged at his memory. Something pertinent but elusive. Crap.

"Oh, really?" snorted Dietlief. "Do you have an elemental analyzer like an X-ray fluorescence spectrometer as part of your equipment in the field?"

"No, they're expensive and not needed. But . . ."

"Exactly!" Dietlief fired the point with his finger. "Paleontologists only take the tools to analyze what they expect to find. Thus, they only find what they expect—bones of simple animals."

"That's crap," spat Bob, "and you

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know it. There'd be something recognizable—something that didn't fit."

"Really? Humans, any human, simply cannot conceive of how long sixty-five million years is. Entire continents moved! Oceans came and went. Species rose and fell. The ice ages which we feel were so far in our past were only twenty thousand years ago. Hell, just think about it! If, around sixty-five million years in our future, a paleontologist digs in the ground and happens to find a Neanderthal skull that we missed and none of our own, his conclusion will be we were slow, dull-witted bipeds who lived by searching for fruit and grubs. Not the intelligent, civilized, cultured population gathered here tonight."

Dietlief paused and bowed slightly toward Mrs. Goldberg standing beside him.

"Now on top of all this," he continued, "sixty-five million years ago is the most recent possible chance for a dinosaur civilization. They were here since over two hundred million years ago. So any evidence of earlier civilizations would more certainly be unrecognizable.

"The time scale is so inconceivably long that no recognizable manufactured object could still exist today!"

Chapter Eight

The last of the thin soup coursed into Vesquith's mouth through the straw. Consciously, he made the loud sucking sound that etiquette required to signify the attempt to reach the very last drop of the delicious meal. Happily, he raised his crest and provided a solid complimentary twitter.

"Thank you, Vesquith." Salik beamed. "The soup was OK then?"

The look of imploring desire filled Salik's face. He had worked very hard to prepare that soup. It had turned out very thin, of course, and pretty gamy. Nonetheless, it was still palatable—and hot.

"It was excellent, Salik, truly," answered Vesquith. "I don't know how you did it. We are all in your debt."

The bow of gratitude that Vesquith made caused a huge smile of joy to flash across Salik's face. In response, he held his bow of humility a bit too long as the relief washed through him, but not so long as to be rude.

Vesquith reached out and gently laid a hand on Salik's cartilaginous wing. The young man had been working so hard and had been so nervous that the fleshy fins had extended to their full breadth to cool him down. They were quite warm to the touch.

"Thanks, Salik," he said quietly. "This really helped. It's just what we all needed."

Salik nodded, then turned back to clean up what had become the small kitchen area near the front of the PET.

Vesquith turned back to look at Tessaril sitting in the back of the bus. She was poring over wiring diagrams, trying to figure a way to reroute power for communications. Gorak was out again. He'd dashed in a half hour ago, rudely slurped down some hot soup, and run back out. He was convinced that the enemy had set up a base somewhere nearby. He'd grown fanatical thinking they were just behind the next crater, just over the horizon.

Actually Vesquith was pleased. After the initial shock and fear that flooded them five days ago, the team had settled down and performed well. Salik and Tessaril had found spare electrical cables and rigged up water electrolysis units to produce oxygen which they stored in the empty tanks of the AMs. Vesquith drove the PET into the motor pool and connected airtight tubes to two similar vehicles. The smallest bus served as an airlock and storage space while the other two became living quarters, air production and control center. The batteries of all three buses were now kept charged using jury-rigged cables to the main power plant outside.

Three days ago, amazingly, even

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Gorak had contributed to their survival instead of roaming around like some insane lizard. He actually had tunneled through the wall into the galley and recovered some food. At first, they all had thought he'd cannibalized some of the AMs, but he had taken them to the hole he'd blasted in the wall. By using several thousand blasts from the AMs' laser rifles, he'd created a hole big enough to get through.

At that point, Gorak had decided that the enemy had wanted their own base near here, that they had taken out the LOP in a preemptive strike, and were hurriedly building a new base somewhere hidden. For the past two days he had steadfastly packed oxygen tanks and food and set off on foot to find them. Vesquith had objected the first time Gorak had suited up. Such excursions would use a good deal of their scant resources. Gorak's snarl of bared teeth and the reminder that he was still in command had quenched any further questions.

Now with air, food and electrical heat, the group had turned their attention to the next step—getting rescued.

Vesquith strolled back to where Tessaril sat absorbed over her diagrams. She frowned intensely, her eye ridges pushed low and forward. Patches of skin were cracked around her neck and arms where her suit had worn through the scales. Even so, to Vesquith she was overwhelmingly beautiful.

"Any luck with the power grid?" he asked quietly, taking the seat across from her.

For a moment she didn't respond. Finally, she raised her head to look at him, but her eyes were focused on something else—something inside her head. Suddenly, an internal switch flipped, and she actually saw him. She smiled.

"Huh? Oh . . . No, not yet," she said, laying down the notebook. She rubbed her eyes and took a deep breath. "I know we can draw the power, but I haven't yet figured out how to impedance-match our cables to the grid. I don't want the junctions to keep burning out every few hours. It'll work, though. I just haven't quite got it."

"Good. You've done a remarkable job already. Just let us know what you want done. Did you get enough to eat?"

"Yes, plenty. Salik is quite a cook. How about you? What's our situation?"

"I'm doing fine. Just blisters and sore muscles. Our situation is pretty good. We've got enough food for two weeks. Your power grid will keep the buses charged so we won't freeze to death. So right now things are OK."

"But . . . ?" Tessaril's eyes looked intently into Vesquith's own. He could easily see that under different circumstances he could never refuse her slightest desire. A look from those crystal blue orbs would vaporize any resistance he might ever generate.

"We're going to need more power," he answered.

Tessaril's mouth fell open.

"More? I can hardly even maintain what we've got now! Why the hell do we need more?"

"I know you're pushed," Vesquith said, raising his hands to appease her, "but within a few days we'll have to decide between water and oxygen. We don't have enough water for both. We'll either have to quit electrolysis or go thirsty."

"Damn!" spat Tessaril. "Could we lean the air out?"

"Not really," answered Vesquith. "I've already reduced the oxygen percentage from our normal thirty-eight percent down to twenty-eight percent. I've also cut the pressure from sixteen psi to ten. We're about as lean as we can go."

"I thought I was breathing heavier . . . and overheating. So what will more power get us? We're out of water, not electricity."

"I think I can get oxygen out of the soil," replied Vesquith. "The regolith

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around here is mostly silicon dioxide but it has a good deal of magnesium and aluminum oxides too. By heating the soil into a liquid magma, we can do the same electrolysis process to produce oxygen. But it needs a high power level at first to melt the stuff. Once it liquefies, the power load to keep it molten would be lower. Does that help?"

"Not much," Tessaril frowned. "OK, let me think about it for awhile. Can we set this up near the power plant instead of in here?"

"Yeah, sure, the magma pit can be out in the vacuum," said Vesquith.

"OK, that helps. Maybe I can use this 'pit' as a resistive shunt to help me solve the impedance problem. When do you need it? . . . Never mind, I know: as soon as possible."

Vesquith shrugged his shoulders, put his hands up, and tried to look innocent.

"Thanks," he said, starting to get up.

Tessaril reached out to lay a hand on his arm.

"Wait, do you need to go?" The gentleness of her touch and the undertone in her voice stopped him instantly.

Choking down the lump in his throat, he managed to gurgle, "No."

"Look, Vesquith, I didn't mean to snap at you. I'm sorry. You've saved us more than once and now this idea may do it again. It's a brilliant move. Thank you."

Tessaril hadn't removed her hand yet. Her eyes bored deeply into Vesquith's again, but now there was something different, something softer. He was sure his soul was exposed.

"It's . . . a . . . not so great. I'm sure . . . um . . . somebody else could . . . a . . . have . . . a . . . come up with a better idea that didn't burden your power grid."

"Don't worry about that," she said. "Fortunately, the designers of this base put in more power than we could ever use—even fully staffed. You just keep coming up with the ideas. I'll get you the power."

"Thanks, Tessaril," Vesquith remained motionless on the edge of his seat, lest she remove her hand.

But the hand went its way, though the touch would remain for several hours.

Chapter Nine

"My, what a beautiful morning!"

Vesquith stood on the side of a mountain and admired the Universe. The nearly full Earth still hung in the sky, a swirl of frothy white and lapis lazuli blue. Stars blazed brightly in the heavens. Even the gritty, gray dust and barren rocky landscape of the local real estate held a certain unique beauty. Life was good.

"Yeah, yeah," came the reply from Salik over the earphones. "Just furrin' glorious. Now flip in the switch marked 'phase lock' and rotate the dish back to its original position."

"OK, no problem," answered Vesquith. The dish swung silently until it again pointed directly at the blue orb above. "Did the background check out?"

"Yeah, it's noisy but livable," came the response. "OK now, flip off the 'test' switch and close 'er up. Let's see what happens. Switch your helmet to comm channel three."

Vesquith made the changes and delicately closed the cover of the panel. The wad of spaghetti wiring inside looked horrible, but so far all the new connections to the PET down below had checked out. The system had power, all connections were clean, and the dish should be working. With any luck, Earth was a phone call away.

Vesquith waited tensely. It had been eight days since their discovery of the shattered base. Three days since he and Tessaril had become mates. Despite the hardships, he couldn't be happier. They had tackled the problems of survival head-on and won. They had plenty of air, hot and cold water, more than enough electricity, and sufficient food for another week. Hopefully, the hydroponics trays would start to produce

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some veggies in a few more days. Otherwise, assuming rescue from Earth wasn't forthcoming, they still might have to resort to fast-frozen AM cooked a la Salik.

Tessaril had even asked him to Merge! Never had he thought such a thing possible. To legally intertwine his line into such a distinguished one as Tessaril's was rare indeed. But when he had pointed out the risks to their survival of staging the Nesting Fight she had just shaken her head. She said she didn't need such an arcane ritual to show her who the best man was. His family would be awestruck. His descendants would revere his image.

But he didn't really care. Whatever she had asked, he would have done. To be able to touch her, to smell her, to stand near her was enough. He would have agreed to be her slave. Oddly enough, she was behaving the same way. Together, they truly seemed to have found happiness on a world devoid of much else.

Needless to say, Gorak had been dumbfounded. He'd returned from one of his paranoid forays over the horizon, exhausted, mumbling to himself and almost out of air. Even in such a state, he couldn't help but notice that something had occurred between Vesquith and Tessaril. If the scratches and smell hadn't been enough, the brightly colored patches on their skin were irrefutable evidence.

Oddly, though, Gorak had accepted it easily. Vesquith had been secretly worried that Gorak would try to assert his rank and offer a claim on Tessaril. Instead, he'd stood in the doorway for several seconds not speaking, just staring at a point in the air between himself and Vesquith. The he let out a "Grumpf," stepped over to the kitchen, grabbed some food packs and went back into the other bus.

Gorak was almost insane by now anyway. The idea of the enemy hiding somewhere had snapped his mind. He swore he was getting static from enemy radio transmissions. Salik hadn't been able to hear any. Still, they hadn't tried to stop Gorak. He was on the edge of going primal. Vesquith figured that, one of these days, Gorak just wouldn't return.

That's why they'd hurried to get the Comdac running.

The Comdac was a complex, pretty impressive piece of gear. A phased array of high power light-emitting-diode transmitter/receivers, it could be focused into a phased beam for secure communications with Earth or dephased to act as an accurate LIght Detection And Ranging, or LIDAR, system that could pinpoint incoming ships over millions of miles.

Now Vesquith just wanted it to be a telephone.

"OK, here we go," came Salik's voice. "Lunar Observation Post One to Earth. LOP-1 to Earth. Can you hear me? Can anybody read me? LOP-1 to Earth. Come in."

Nothing.

White noise fizzed faintly in Vesquith's ears.

"Vesquith? You still on site?"

"Yes, Tessaril, I'm here."

"Good. You know that rheostat we put into the sidelobe damping circuit? Turn it up about one-quarter turn."

"You sure?" answered Vesquith. "Won't that overload the little bridge we put in?"

"It'll handle it."

"OK, as you wish."

Salik's voice returned and repeated his call. Vesquith could imagine the flurry of action below in the PET as the two of them tried desperately to adjust voltages and makeshift controls. This had to work. They had to reach someone.

"This is the MSS Hisgar. Identify yourself."

"YAHOO!" Vesquith screamed without thinking. He leaped up in a rush of joy. It worked! They were saved! Someone heard them.

Then he realized he'd just leaped

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high into the vacuum off the side of a mountain.

For a brief moment, an electric shock of unbridled fear blasted through him. He was up pretty high. Then he got his bearings.

No sweat. One advantage of being on the Moon was it took longer for objects to fall compared to Earth. He scoped his landing site, hit, somersaulted, and bounced on down the mountain.

Tessaril was waiting for him at the door.

Chapter Ten

"Just think, ladies and gentlemen, of what must have stood here before these mountains were even born. Here where the great inland ocean created a coastline bathed in glorious sunshine, near a dense, rich jungle swarming with diverse life. Great cities, large pyramids, art, science—who knows what resplendent structures may have risen above the trees to bask in the sun's warmth. And now—all gone—lost. So where's that last piece of real evidence, as that young man pointed out earlier this evening? Where's the wrench? It could be just under our noses, ten feet further down in the rock below the foundation of this building. Or maybe it's buried out under the ocean. Who knows? All we can do is to keep searching, keep digging. And with your generous support, perhaps one day we'll discover the mechanic after all. Until then, I thank you all for a delightful evening and wish you well."

Dietlief raised his glass into the air one last time, boomed out "To the unknown!" and drained it. The crowd immediately converged upon him, amid ample applause, impeding his obvious desire to get to the exit.

Bob leaned against one of the huge, granite pillars that extended forty feet up to the ceiling of the great hall.

What a load of crap, he thought to himself. *Here I bust my ass for months digging and brushing and baking in the sun doing the real work, and who cares? But let this overgrown blowhard spout some absolute fantasy and look at the crowd fawn over him. Asshole! It just isn't fair. Where's the Cosmic justice?*

"You look like your girl just ran away with the milkman."

Bob twisted slightly to look over his shoulder at the familiar voice.

"Hi, Veronica," he said morosely. "What?"

"By the look on your face, your girl just dumped you. You know, that look of both sad and kinda pissed off at the same time. I've been watching you. Your face is like a billboard that keeps shifting from one second to the next. You OK?"

"Yeah, I'm OK. Just not the big party type, I guess."

"Well, I'm glad you showed up anyway. I appreciate it," she said.

"Sure, anytime," Bob answered sourly. "Only next time, can you get somebody I can talk to who knows what he's talking about? Not some clown like this Dietlief."

"What?" Veronica said, surprised. "Despite what you're thinking, this function was a great success. Dr. Dietlief was perfect."

Bob wheeled around to face the woman.

"Ah, come on, Veronica, not you, too. The guy's as phony as a three dollar bill. He's full of bullshit. How can you say that? Hell, we've known each other for fifteen years, been diggin' together, trudged through swamps and deserts doing the real work. How can you stomach this crap about intelligent dinosaurs?"

"Stomped through the desert like the dig you're on now?" she answered.

"Huh? Yeah, just like that. We've found an almost total skeleton of a new species. You remember that skull Bakker found a few years back—the one he called nano-tyrannosaurus. We found something similar but smaller—large optic nerve channels and olfactory cavity.

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Ours is only about eight feet tip to tail. We think it's got bones of something else in its belly. Yet we can't continue, we're out of money. But good ol' Dietlief can walk in here with his make-believe story and in a few short hours get a big fee—for what?"

"For your project." Veronica's look was dead serious but also just a bit coy.

"Huh?" Bob was lost.

"Dr. Dietlief spouts crap. You know it—I know it. But it's a good story, it hangs together well, and it's exciting. It lets people dream and see the glories of lost worlds. To the people here tonight, it even stood up to the questioning of a local but renowned paleontologist."

"Me?"

"Yup." Veronica was enjoying this. She flipped her long dark hair back over her shoulder. The lights from the chandelier sparkled off her deep blue eyes. "You. You see, he catches their imagination. He makes them see, in their own minds, unknown treasures and past wonders. You feel the same excitement when you make a new find in the rocks, some bit of bone or an imprint of skin. Most people can't get excited over that. They recognize consciously that what you do is the important part but they mostly just see bones. But if some long-dead civilization once roamed these very hills, think how fascinating that must have been."

"So what? So they're entertained. It's all poppycock. You've misled them."

"Possibly. Who knows?" answered Veronica. The tone in her voice made it clear that Bob's point troubled her. She turned away and picked at a nonexistent blemish on her sparkling gown. "Dietlief catches their attention. He makes them—interested in the work."

"Again, so what? So does some made-up crap about some civilization sixty million years in our future, but it has no connection to reality!"

"Attentive people open their checkbooks," replied Veronica quietly. "Many of the guests here tonight are quite wealthy. We've already received pledges for over six hundred thousand dollars. More will come in over the next few days."

"Wha . . . you're kidding!" stuttered Bob. "Over half a million bucks?"

"Yes. Part of which will go into the field support fund."

"You mean my dig . . ."

"Can now be completed as you wanted." The smile on her face beamed her delight at surprising him. "You can even hire two more students. Maybe even that ground-penetrating radar you've been so bothersome about."

Bob stood with his mouth wide open. At first he was stunned by the amount of money she'd spoken of, then the joy of continuing the dig, then relief at seeing his financial pressures evaporate, and finally excitement at the thought of a radar.

Then another thought came to mind. One that Veronica had evidently already dealt with.

He took a long last drink from his glass.

"So the end justifies the means, is that it? As long as I get a big enough piece to get what I want, then I should support whatever method it took to get it. Machievelli and me, huh?"

"That's up to you," Veronica said. "You don't have to take the money. Lord knows there's plenty of others waiting in line for it."

Bob shot a long, deep look into Veronica's eyes. Beautiful eyes they were, sensuous, alluring—Bob knew they could be cold steel when necessary. Now, though, he saw the mischievous glint, not a serious threat.

"You've got a mean streak in you, you know that?"

"Not at all," she replied. "I don't make the rules, I just play the game as best I can. You want the money or not?"

"I'll think about it," said Bob, "for maybe a microsecond. Of course I want it. A new radar would be wonderful."

"Good," answered Veronica. "Of

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course you could always buy an X-ray fluorescence spectrometer instead, like Dr. Dietlief said, to look for strange elements. Who knows, maybe you'd find the fabled wrench."

"I'll pass, thank you," replied Bob.

"Oh, and don't worry about being a prostitute, you get used to it."

Bob chuckled as they started walking toward the bar. The place was deserted now. No one left in the huge empty space. The click of Veronica's high heels echoed off the walls.

"That's about the size of it, isn't it?" he said. "I'll do anything for money. 'Twenty bucks—same as in town'?"

Veronica laughed at the old punch line. "Well, you're a bit more expensive than twenty bucks and, Lord knows, you take more than an hour to get results."

"Hey, I do quality work," answered Bob as if insulted. "Besides, if I'm the prostitute, what's that make you?"

"The pimp," answered Veronica matter-of-factly.

They sat for a while as the strain of the evening drained from them. Eventually they left, each to go dream their own dreams and do the best they could.

Chapter Eleven

The door slammed open.

The whole bus shook at the crash.

Gorak staggered into the room, pawing at his helmet. Burn marks and dust covered his space suit. A newly applied suit patch covered a large area of his side.

Vesquith caught the staggering figure as he fell.

"What the hell!" he blurted.

Salik got the helmet off. Gorak gasped huge gulps of air.

"Found 'em," he croaked. "Not . . . too far."

"What?" fired Tessaril. "Found who?"

"Enemy . . . have base . . . 'bout ten kliks."

"Salik, get him some water," said Tessaril. "Vesquith, let's get him up on the bench."

"OK, Gorak," said Vesquith, sitting Gorak down on the opposite bench. "Slow down. Tell us exactly what happened."

Gorak nodded his head. Color was coming back into his eyes and snout.

"OK, don't have much time, though . . . Think they're following. Couldn't cover trail . . . was running out of air."

Vesquith cocked his head to look at Tessaril and Salik. He was skeptical, and tried to ask each of them, with his look, what they thought. Tessaril looked worried. Salik shrugged.

Vesquith stroked his chin. Gorak must be hallucinating. He'd been getting more neurotic with each passing day. Perhaps searching so hard for the enemy, he'd finally found them in his mind.

So now the problem was how to calm him down without forcible restraint. If Gorak saw they didn't believe him, he might get violent. What if he ordered them to suit up and go out? Was he still in command? They were about to be saved! The ship Hisgar said a lander would come in three days. All they had to do was get by. Vesquith couldn't allow some paranoid captain to go nutso and shoot up the joint, not now.

"Look, Gorak, we're OK. We're going to be rescued. We've made it."

Gorak opened his eyes and stared at Vesquith. "What do you mean?"

"We've established contact with the fleet at Earth. They're sending a rescue ship. We're saved."

"Glat!" snapped Gorak. "That must be what triggered 'em. They must have detected your transmissions. That's why they left their base!"

"Now, hold on, maybe it just seemed like you saw somebody. Did you fall down somewhere? Hit your head?"

Gorak's leap caught Vesquith by surprise. Claws snapped onto his shoulders and pinned him against the wall. Gorak's face snarled inches from his own.

"I'm telling you I found them. I was coming back in from sector eight. I'd already been over that area before but

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hadn't seen anything. Halfway here I found new tracks. Six of them were on their way here. I came up behind them and surprised them. A couple got shots off. I got winged. When they don't report, the rest will come for us. They're here. They know we're here. I don't know how many there are. We've got to get ready."

Vesquith tried, at first, to push Gorak away gently. When he couldn't, he broke the hold forcibly and shoved.

Gorak fell back onto the bench seat with a thud. He clutched at his side. His lips pulled back in a grimace of pain.

"I'm tellin' you, they're comin'. We've got to get ready. We've got to go out and kill all those smooth-skinned mammal-fathered bastards!"

Vesquith looked again to Tessaril and Salik. All he saw in their faces was as much uncertainty as he felt. Gorak must have totally flipped out. Tessaril stepped over and knelt down beside Gorak. She gently moved his hands away from the smudged area on his side. "Gorak, are you sure? Absolutely sure?" Tessaril asked as she examined the patch. Her voice was smooth and steady but demanded the truth.

Gorak took a deep breath, an action which caused another involuntary flinch. "Yes, I'm absolutely sure. I saw a glint on the horizon as I was on the way back. I moved to intercept it. As I approached I saw a group of six soldiers, clustered, moving slowly. They were doggin' pretty heavy packs by the look of it. I could tell it wasn't you guys, so I set up to ambush them on the far side of the next crater. I got four before they knew what hit 'em. The other two fired back but only one had a laser. The other was shootin' a slug thrower. They couldn't find any cover anyway. I nailed 'em but got winged by a laser shot and took some shrapnel from one of those slugs. I made sure they were all dead and I humped it back here as fast as I could. I didn't do a very good job on the patch. Air almost didn't make it."

Vesquith looked at Tessaril.

"His suit has been punctured. Could have been a laser or a slug," she said.

"Who were they?" asked Vesquith.

"Martians." Gorak spat the words. "They had little pictures of the great Rornak on their sleeves."

"Why didn't you radio for help?" Salik paced in a short circle in the kitchen.

"Didn't want to risk my surprise," answered Gorak. "Afterward I realized I'd been hit. I tried to call after I'd patched up, but the radio was gone. I decided to run for it and hope my air held. Look, I know I've been acting nuts. I know I haven't been your commander. You all have saved our skins without me. I know this. I'm not going to try to order you to do anything, but I swear on my memory of my Line's Originator, they're out there and they'll be coming here."

For several seconds, silence reigned as the other three assimilated what Gorak had said.

"Damn. OK, then," Vesquith broke the quiet. "Maybe our comm link to the Hisgar gave off some RF. We certainly didn't try to shield the communications. All that rewiring may have radiated some of the signal. The timing is right. So maybe the Martians heard we were here and sent a team. They couldn't have intercepted our conversation, and can't know help is on the way. If we can hold out for three days, we'll have plenty of firepower to get rid of them. All we have to do is batten up this place and make a stand."

"No!" Gorak snapped. "We've got to go out and kill the bastards. We can track them right back to their base. We can rig up some explosives or something. We can catch them by surprise now."

"How?" Vesquith shot back. "You think they won't notice that their podmates haven't called in? How can we get enough oxygen and stuff to lay siege to their base? We're barely surviving here! Besides, how many are there? We could be horribly outgunned. If we as-

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sume a defensive role, we can put the burden on them. There're only two ways into this tunnel—both can be sealed off. It'll take them a couple of days to get enough stuff together to break into here. If we can delay them slightly, the Marines can get here to mop them up."

"Vesquith's right, Gorak," said Tessaril. "This is the best strategy."

Gorak snarled in his throat and looked to Salik.

"I want to rip them up, too, Gorak," Salik answered. "But a hopeless attack will not help. We can live and defend this place for days."

Gorak growled again but finally nodded. "OK, but we can still set up to cost them a few. They'll have to come down the one corridor or through the big front doors. We can set up sniper sites. Some of the AMs brought those big hundred-kilojoule tank busters. If we set one up at each point, we can peg 'em hard."

"Agreed," said Vesquith. "Salik can help you."

"Tessaril, we need to talk to the Hisgar again. Maybe they can speed up their rescue. We'll also need to fill all the oxygen tanks we can."

"Right. Water, too. I'll take care of that."

"Good point. Salik . . ."

Salik stopped in the doorway.

Vesquith walked over to stand next to Salik. Gorak was already in the airlock bus. Tessaril was in the back grabbing her backpack.

"Salik," Vesquith said quietly. "Remind Gorak that we're on water rations as of now."

"Good point. Shall do." Salik started to turn to leave. Vesquith caught his arm.

"One more thing." Vesquith's voice was a whisper.

Salik turned back, puzzled.

"We'll be out of food in a few days. We can't tend the hydroponics. We may need something else if this lasts longer than expected."

"What?" asked Salik. "There's nothing else around . . . Oh!"

"Can you do it?" asked Vesquith.

Salik's face pinched into a troubled grimace. The unpleasantness of the task battled with the necessity.

"Yeah, but only one guy," answered Salik. "And I'll say a prayer to the First One to Breathe to bless his line."

"Good, thanks. And get his tag. We'll want to tell his Line Father when we get back."

Salik nodded and was gone.

"Will you really be able to eat one of us?" Tessaril was standing behind him.

Vesquith turned to look at her. "Maybe not, if it was just me. But if it keeps me alive to defend you, I will. I promise you, on the souls of the three hundred forty-seven Line Fathers of the Tassergil clan, that you will not die here as long as I live."

Tessaril stared intensely into Vesquith's eyes. The long vertical slits of her pupils widened in admiration, gratitude and love.

"If we survive this," she whispered, "I will thank the Gods for having placed me here that I might meet you and merge our lines. I pledge myself and all I represent to you, Vesquith of the Clan of Tassergil, I will find no other."

Vesquith started to speak, to tell her all the things in his heart. Tessaril gently put a finger to his lips. "Later. Now we must work."

Vesquith was only concerned that "later" might never come.

Chapter Twelve

Vesquith was dead.

The ragged piece of steel that he'd just plunged into the belly of the soldier was snagged. He couldn't pull it out. In slow motion, it seemed, another body was in mid-air coming right at him. In less than half a second, Vesquith would feel the white flash of the enemy's pike as it bore its way through scales, bone and muscle. Oddly, scenes from his boyhood started to race through his mind.

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A blinding flash splashed his eyes. But no pain. The flying figure of the enemy veered to the side and landed, smoking, at his feet.

Gorak, leaning against the wall all the way across the cavern, had made one last great shot.

Realizing he was alive, Vesquith leaped over the bodies around him and sprang toward the PETs. Tessaril and Salik were hand-to-hand with three more of the enemy. Vesquith smashed into them with a fury that he had never known.

He threw the first of them up into the air, smashed the second with a spin-whip of his tail. The figure smashed headfirst into the bumper of the bus. Vesquith watched long enough to see glass and air from the shattered helmet blast out into the vacuum. Warned by the action, the third turned to accept his attack. Tessaril leaped and plunged her own dagger through its backpack and into its heart. Vesquith grabbed the pike from its dying claws in time to spear the flailing, falling body of the first one.

All lay dead.

"Go check the door," Tessaril gasped. "Get Gorak."

Vesquith didn't move. First he looked at Tessaril's suit to see any wounds or leaks.

"I'm OK," she assured him. "Go."

Vesquith turned to look around the motor pool. A huge ragged hole gaped in the massive front doors. All around the cavern lay bodies of dead enemy. At least fifteen had come through the breach. At least seven more lay outside in the dust, victims of Gorak's excellent marksmanship.

Vesquith hurried over to Gorak. Gorak had accepted the direct attack of six of the enemy before falling. He had served his Line well. Too many dark streaks, though, from too many wounds, covered his suit. There was no doubt he was dead.

Vesquith hurried to the huge doors. No more soldiers could be seen, only corpses. Still, he was positive a few more were out there and more were coming. The enemy really wanted Vesquith and his group dead.

"How's it look?" Tessaril's voice sounded solid. She was in good shape.

"Gorak's gone," replied Vesquith. "I don't see any action outside. Got a hole, ten feet diameter, in the doors. I'm gonna plug it with bodies and drive the spare PET in front of it."

"Good. Look for guns while you're at it. Ours are all spent."

"Got it. How's Salik?"

"Not good," came her voice. "I got him inside before his air ran out. He's alive, but lost a lot of blood. He's lost an arm and and most of his tail."

Vesquith heard a quiver in her voice.

"He did well, Tessaril. Do what you can for him."

Her voice broke.

"He took a blade for me, Vesquith. I was caught off guard . . . didn't see it. He jumped in front of me."

Thank you, Salik, Vesquith thought to himself. "Then we shall honor him, and the Line of our children shall bear his name through time," he said.

Silence.

When Tessaril finally spoke, her voice was better.

"Agreed. I will tend to him as I can. Do you need me to help?"

"No, I don't think so. I think it best to stabilize Salik. Then call the Hisgar. I suspect our dish will be found shortly and we'll lose the link. If somebody jumps out at me, I'll be sure to yell."

"OK, but be careful. Don't expose yourself. They still may have a sniper out there."

Vesquith tried to hurry, but fatigue slowed his movements. As quickly as he could, he piled the dead soldiers in the hole in the doors. All except the six near Gorak. Those he left as a monument to a warrior. That monument might last for a million years, a tribute to the Line of Gorak's clan. After all,

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Gorak had saved their lives. If that original group of six soldiers had caught them by surprise in their buses, Vesquith would be a freeze-dried lump by now.

Vesquith parked the bus as close to the doors as possible. He didn't figure the bodies minded being squished.

As he got out of the PET, he surveyed the area and their situation. Gorak's sniper nest by the great doors had been destroyed. All of the AM's guns were used up. The enemy had found and cut their cables to the fusion power plant yesterday. Now they had only the buses' batteries. Still, they'd held out for four days already. They could maybe make two more. If the marines could get through, they had a chance.

The first rescue boat had pushed it up to the Moon in under two days. Undetected by them, however, was the stealth ship of the enemy in orbit. The AMs hadn't expected a space fight. Surprised, they'd been blasted out of orbit. Those that survived, if any, were four-hundred kliks away holed up in sector fourteen.

Because of the enemy ship, though, Earth had deployed a battleship to the Moon. The Hisgar herself was en route. She'd arrive sometime in the next twenty hours.

Vesquith picked up what guns he could find and went inside. Oddly, he found no laser guns, only old slug throwers, pikes, and long daggers. Cycling through the airlock bus, he popped his helmet and entered the bus.

Salik was lying on the bench seat with Tessaril beside him. He breathed in ragged gasps. He looked like hell. Bloody stumps lay oozing where once strong limbs had been.

"How is he?" Vesquith asked.

Tessaril looked up. Huge tears welled in her eyes. Bright blue streaks of sadness crept down the sides of her face. Vesquith had never seen her weep before. She slowly shook her head.

"Sleep well, my brave friend," he whispered. Dutifully he let the tears he wept fall into Salik's mouth. Though not Vesquith's religion, Salik's Line believed that the tears gave a drink for the soul on its journey to the Land of the Dead. Without the drink the soul couldn't withstand the journey to meet the souls of the oldest ancestors.

"Vesquith," called Tessaril. "Admiral Kakori is on line."

Vesquith hurried into the other bus.

". . . have already dispatched the two ships we found in orbit. AMs are on the way!"

Tessaril leaped into Vesquith's arms. A wave of joy swept over them both.

"Admiral, how'd you get here so fast?" Vesquith asked.

"After we lost the first boat, we realized the Martians were placing a much higher value on the LOP as a military target. We burned hot and hard to get here. That's one advantage of having a nuclear fission rocket on board, we can push ourselves when we have to. Used almost all our fuel though. Refueling tankers will catch up soon."

"Great! We couldn't be happier . . ."

Vesquith's breath caught in his throat. Outside a figure was squeezing through the gap between the doors and the bus. As the first one scrambled slowly over the piled bodies, another entered the gap.

"Admiral, can't talk, enemy coming in!" Vesquith switched off the link.

Tessaril gasped and looked out. In two steps she'd crossed into the other bus and returned with helmets and guns. In seconds, they were both pressurized, cocked and SROCED.

"Kill the lights inside and go by Salik. I'll draw their fire here. You cross fire, but wait 'til they're in good view."

"No, we die together." Tessaril's reply was hard, unshakable. "I'll not leave you again."

Vesquith looked at her as best he could through the helmet. She was dirty, patched and exhausted. She would never be more beautiful than now.

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"I am yours forever," he said quietly. "I will serve your Line 'til the end."

"And I yours."

Chapter Thirteen

Vesquith stepped through the doorway into the control room of the Hisgar. The room was huge compared to other spaceships he'd seen. It was also the quietest. Flagship of the new fleet, the Hisgar had state-of-the-art multisensory controls. Along the walls, sailors sat with their headsets in place, black tactile gloves fitted on each three-fingered hand. Each of them saw, heard, and felt different aspects of the data being pumped into their stations. The room was absolutely quiet, yet Vesquith knew that commands and questions were flashing among the stations at a furious rate.

Tessaril was up front by the captain's chair. She looked stunning. Brilliant patches of green and orange showed in her crest. She was excited. All bathed and scrubbed in a borrowed, close-fitting AM uniform, she could have commanded armies to fight to the death over her.

The admiral was engaged in silent communication. Vesquith approached and stood to attention next to Tessaril.

Two hours ago, Vesquith had thought they were dead. Seeing the armed soldiers enter through the big doors, he hadn't expected to be breathing much longer. But the lead soldier had laid down his weapon and pointed at his helmet. Vesquith had switched to RF from the SROCE to hear Admiral Kakori yelling at him to not shoot their rescuers. Master Sergeant Slaneth had then introduced himself, assessed the situation, and had them immediately ferried up to the Hisgar safely in orbit.

Before seeing the Admiral, though, they had demanded that the two take showers. Evidently, they had stunk.

"Ah, Lieutenant Vesquith, welcome to the bridge," said the Admiral glancing up. "At ease."

"Admiral," Vesquith said crisply.

The admiral punched a button on his chair. Suddenly a voice filled the room.

"All secure, sir. It's a bit of a mess down here. Looks like we're too late for the fun. Too bad, too. From what I can see, there was a hell of a fight. It appears, sir, that our forces dispatched a vastly superior force with only two casualties. Almost as good as we'd have done it."

"Excellent, Sergeant. Carry on, Hisgar out." The admiral stood, took a couple of steps as if in deep thought, then turned to face the two newcomers. "Well done, you two. Remarkable, really. Sergeant Slaneth reported earlier that he'd never seen anything like what you rigged together down there. And then to top it off, you fix the Comdac and reveal the presence of an enemy ship hiding invisibly in orbit here. You may have saved us a devastating defeat later on by revealing the new stealth technology the Rornakites have developed. Astounding."

"Sir?" Vesquith was lost. What ship?

Admiral Kakori stood and slowly shook his head. Quietly he just stood there for several seconds staring into nothing. Vesquith could easily see where being on this bridge could be very unnerving if you weren't plugged into the comm chatter. Eventually the Admiral heard what he needed.

"Lieutenants Tesseril and Vesquith, as commander of the United Space Forces of Earth, I have been authorized to promote you both to the rank of captain. Congratulations. You will be formally sworn in after you return to Earth as soon as we can arrange a shuttle."

"Thank you, sir," said Vesquith snapping to attention. He snuck a sidelong glance at Tesseril. She smiled.

"No problem, Captain." The admiral now appeared to relax and seemed to enjoy addressing Vesquith by his new rank. "Ah, yes, as I was saying to Captain Tessaril earlier, after your base was destroyed, we realized that the Rornakites

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were farther along in their war plans than we had assumed. Evidently, they've been planning to break away for some time. Removal of your base was the start of a major engagement."

"But why remove the LOP? We can't see much more than you can with the Hisgar," said Vesquith.

"That's what we thought, too," replied Admiral Kakori. "But we were wrong. Knowing our technology, the Rornakites concentrated their research on developing stealth ships. They're undetectable by radar or by passive infrared. To LIDAR, however, they are visible."

"Ah, the wide angle scan of our phased array dish . . ." started Vesquith.

". . . could see anything they had with plenty of warning," finished Tessaril. "So they took us out first."

"With what?" asked Vesquith.

"I was just getting to that point when you got here," said the admiral. "Evidently a meteoroid, carefully maneuvered at just the right delta-vee and inclination using small nuclear explosions. They placed a large, cold piece of iron meteorite at very, very high speed right on top of the base."

"By the First One! Of course, with no atmosphere to deflect it, they could hit us with pinpoint accuracy," said Vesquith.

"Exactly," said the admiral, "and relatively undetected. No nuclear blast close enough to Earth to see, no long-term radiation—just a large rock hitting the Moon."

"But was it coincidence, just after the AMs arrived?" Tessaril asked.

"No. We are well aware that the Rornakites have sympathizers at home. We try to control it, but keeping the moves of two hundred AMs quiet is not an easy task. The Rornakites were tipped."

"So did they attack Earth fleet while we were blind?" Vesquith suddenly was confused. The Hisgar was here, had been available, so no attack must have occurred.

"They did, but they only had five ships. The battle lasted for six days. We finally were able to pin down the last one. They didn't really do much damage to the fleet, but we were pretty busy for a while."

"So no ships were lost? None?"

"Nope."

"But I don't understand, sir. Something's funny here," puzzled Vesquith. "They know our technology, and they have spies around. Thus, they know the size of the fleet in orbit. Why send five ships on a suicide mission?"

"We wondered that, too. We figure it was for PR and to establish a negotiating position. If we know they can get to us, then maybe our government will agree to a peaceful separation."

"That makes sense," confirmed Tessaril. "The High Council will be hesitant now. They may want to keep the fleet in orbit for defense."

"Well, OK," said Vesquith. "But it seems not quite right to me. Seems like a major effort to squash the LOP just for a five-ship attack. And why did it take seven days to get them?"

"Who knows?" said the admiral. "They kept in high orbits and flitted around. They kept avoiding any direct contact. Who can say why. These are a bunch of perverted colonists. No real military training. We eventually tracked them down."

"Well, we're obviously glad you did. We couldn't have held out much longer." Something still troubled Vesquith. Something wasn't right in all this.

"By the way," said Kakori, holding a hand to his earplug, "our team looking over your repairs on the Comdac dish extends its compliments on your work. 'Admittedly crude and jumbled' is the way they put it, I believe, 'but remarkably executed given the tools and conditions available'."

"Thank you, sir," said Tessaril.

"We're about to turn it on now in wide-field mode."

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The admiral paused and listened to his earpieces. Though the bridge conversations were ever present, he was obviously adept at carrying on multiple conversations at once. "Just in case another Rornakite ship may be hiding and watching. Excuse me a moment."

Vesquith backed off a step with Tessaril.

"You clean up really nice, my Lady," he said softly.

"Oh, quit, you." Tessaril actually flushed slightly. Small pink patches dotted the bony ridges on the sides of her crest. "You do, too, Captain."

"Thank you, Captain," replied Vesquith.

"Perhaps," she purred, "we could leave the technical work to these fine soldiers and we could continue our discussion in my quarters. After all, I've seen a LIDAR scan before. If you've seen one, you've seen 'em all."

The glint in her eye slits was enough for Vesquith. Although his species had been civilized for three hundred thousand years, the fifty million years of evolution in his blood now took over. Vesquith looked to Admiral Kakori and bowed to request departure. The Admiral waved a partial salute and turned toward one of the consoles. Vesquith quickly followed Tessaril out the door and down the hall.

"By the First, woman," he called softly, "If you swing your tail any wider, you'll dent the walls."

"That's how Captains walk. Like it?" Tesseril's laugh danced down the corridor like a songbird's twitter in a forest.

Vesquith growled deep in his throat. The wings along his back bristled. Once again, millions of years of evolution enforced their will on his body's responses.

"Yes!" as the door closed behind him.

Chapter Fourteen

Admiral Kakori sat in his chair and watched the two depart the bridge. A slight smile creased his lips. Turning in his chair, he closely watched/listened to the flow of information passing around the bridge. It was a good crew—efficient, well trained. They were anxious to get into the fight, though.

Soon enough. Right after the enemy here on the surface was mopped up and they were sure cislunar space was clear of enemy ships, they'd launch the fleet. He hadn't told the new captains, nor anyone else in the crew, except the command staff. The High Council was feigning backing off. It was a ruse. Within three days, the orbital fleet would embark for Mars. They would annihilate the Rornak fleet, depose the would-be king and establish a military-based colony.

And the Martians could not stop it. They were hopelessly outgunned. Their resources were strained as it was. They were at their limits. After all, Earth had her spies too.

The only real threat was a massive nuclear bombardment of the Earth. Some way or other, the Rornakites had obtained quite a number of fission bombs. Computer simulations indicated that a massive strike with all their weapons could raise tons of dust and gas into the upper atmosphere. The gas would react with the air and the dust would close off the life giving sunlight to the giant algae beds in the seas. It would tip the ecological balance. The oxygen concentration would drop by almost half, down to twenty-two percent. Such a change would kill most of the larger creatures on the planet. Civilization would end. After millions of years of existence, the People would die.

Kakori couldn't believe that anyone would be fool enough to kill everything on the planet. Rornak couldn't be that stupid. He might want to build an empire, but even he couldn't be so insane. He'd destroy life for centuries. The residual radioactivity would infiltrate the life cycles and wreak havoc. Kakori had argued to the Great Council that an all-out nuclear strike was not the threat. A small strike against selected cities, however, was entirely viable.

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The easiest way to prevent this was to strike first. The Council had ordered Kakori to Mars to vanquish the Rornak fleet. Without the ships, the threat would no longer exist. He had gladly accepted. With this crew, this ship, and this fleet, he would eradicate the enemy.

"Admiral . . . Ranging, sir. . . ." came a voice.

"Aye, Ranging."

"Admiral, ground-based LIDAR system is operational. Noise level high but acceptable. Near-range scan complete. Clean space, sir. No unidentified ships, sir. Repeat, no enemy ships."

"Excellent, Ranging. Initiate deep space sweep. See if anyone's coming in or hiding out there somewhere."

"Aye, aye, sir."

"Hisgar to ground base. Sergeant Slaneth . . . you there?" asked the Captain.

"Aye, Captain."

"Status, Sergeant."

"Advance team reports modest effort. Only six enemy present at their outpost in the crater. About twelve kliks from here. They've holed up and refuse to surrender. It'll take an hour or two to root 'em out."

"Very good, Sergeant. Take care of the problem and get back up here as soon as possible. We'll let the tag-alongs come up in a few days and clean the place up. We've got someplace to go."

"Aye, aye, Captain. I'll hurry things up a bit." The new excitement in Slaneth's voice came through clear. The sergeant must have guessed or heard the rumors of the impending mission. Despite all efforts at security, the rumors still leak out. Kakori could well imagine the ragging the sergeant was just starting to deliver to the ground-pounders down below to hurry things up. Ah well, life as a marine.

Kakori began concentrating on the impending mission. Encrypted messages were sent to the other fleet captains. The refueling ships were directed to increase speed. A thousand details to consider and delegate. He tended to them each with a practiced hand.

"Captain . . . Ranging, sir."

Kakori snapped out of his conversations. The clock said three hours had passed.

"Aye, Ranging. What is it sailor?"

"Captain . . . we've got long-range contact, sir."

The voice was calm, in control, but the words sent a flash of electricity through Kakori. Another attack? Damn! If the Hisgar was caught out of position away from the Earth, heavy losses were probable. Damn it twice.

"How many, Ranging? Formation?"

"Count fifteen, sir."

"Distance?"

"Estimate three days out, sir."

"What? Three days! How can you see them that far out?"

"They're big, sir. Estimate the biggest at fifteen kilometers diameter. Could be more, smaller than four kliks we can't see."

Fifteen kilometers!? No ship could be that big. The Rornakites didn't have the factories. Hell, how could it move? It'd take a nuclear blast to move a ship that size.

Damn!

Asteroids. The tail-busted bastards had a swarm of asteroids flying toward the Earth. Non-nuclear but with nuclear-sized impacts. Unstoppable. They'd used their nuclear weapons to push the mountains of rock out of the asteroid belt to fall on the Earth. The total impact would be like a hundred megatons or more. The big lifeforms will die out, but the life cycles of the lower forms would be unchanged.

Of course! Their earlier attack had been to just delay the fleet. They took out the LOP to remove any chance of early warning. Given a bit more time, the fleet could have intercepted the swarm and deflected the rocks with their own thermonuclear weapons. Sacrificing five ships had induced the Earth government had relaxed its alert. Now it was too late.

Captain Kakori sat back in his chair.

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Damned fanatics. They must hope to kill all the sentient life and move back to Earth. Bastards.

"Captain to ground."

"Sergeant Slaneth, sir."

"Sergeant, get your asses up here immediately. Evacuate the area. Leave the enemy."

"Sir?"

"Now, Sergeant!"

"Aye, aye, sir."

Hell, maybe in a few thousand years life would return to normal on Earth. The admiral wondered whether the new inheritors would remember his kind or even recognize their tremendous accomplishments. He'd once heard a lecturer state that their bodies were the culmination of so many years of evolution that they were the perfect creature. Tails for balance, scales to protect against the intense solar radiation, incredibly sensitive sight, smell and hearing. Since their ancestors first branched off from the amphibians two hundred million years ago, their race had become the perfect rulers of the planet. *Maybe we'll survive this*, he thought to himself. *But if I have any say in it, it sure as hell won't be the clan of Rornak.*

"Captain to Comm."

"Aye, Captain."

"Inform the fleet. We launch for Mars immediately!"

Chapter Fifteen

Bob stepped out and let the flap of the tent fall silently behind him. A faint puff of breeze wafted over his face with gentle fingers. The air was clean, thin, and crisp. The sun had a pleasant warmth and an intense brightness. The high desert of Utah was one of the most beautiful areas of the world.

If only it weren't so dry, he thought to himself for the ten thousandth time. *A little grass and a few leafy trees—it'd be perfect.*

Flipping down his sunglasses like a pilot ready to mount his jet, Bob strode across the dusty, dry arroyo towards the site. Everyone else was already up there bustling around. Today they would mount the plaster-encased fossils onto the truck to begin the long journey back to the Museum.

Bob hiked up the steep embankment to where a lanky young man with a scraggly beard stood above the others overseeing the action. The beard and face were covered in dust and bits of plaster. A purple, tie-dyed shirt covered the man's bony frame.

The younger man waved as Bob approached.

"Hey, Bob. Glad you're back. We're just about to load this baby onto the sled. Truck should be here soon. How was the trip?"

Bob looked at the large, oblong, brown lump perched on the edge of the narrow ledge cut into the slope of the hill. Under the burlap, buried safely in the heart of the plaster, lay the small forearm and shoulder bones that he'd found weeks before. They still hadn't found the skull, though.

"Excellent, Rusty, looks good," Bob said. "Trip was . . . interesting."

"Oh?" The grin on Rusty's face tried vainly to imply an innocence in the question. "Did you see Veronica?"

"Yeah . . . at the party."

"And?"

"And nothin'," Bob answered turning to look at the snickering younger man. "We discussed the dig and other business."

"Ah, come on, man. It's the 'other business' I'm talkin' about. Shit, man, Veronica's the hottest-lookin' woman I've ever seen. Why don't you hit on 'er and sweep 'er off her feet?"

"Circumstances weren't right," answered Bob resignedly. "Besides, she's well above my station. She'll be finding some CEO or something someday."

"That's a load of doggie muffins and you know it," snorted Rusty. "She's just like any other female. She just acts kinda highbrow sometimes."

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"Well, maybe," said Bob. "Anyway, while we're waiting for the truck, why don't you get everybody to help me unload some of the gear I brought back?"

"Sure, they'll be through here in ten minutes. . . . Gear?" Rusty's head perked up. "Do we have new toys?"

"Well," said Bob teasingly, "it appears, due to extensive amounts of groveling and boot-shining, that we may have a new ground-penetrating-radar unit. Some assembly required."

Rusty stood with his mouth wide open. "What? You got us a GPR? Out of Veronica? Hell's potatoes! Why didn't you say so? When you said the trip was interesting, I didn't realize what you meant. Shees. What else happened? Did you win the lottery?"

"No, nothin' like that," said Bob.

"Well, a new GPR ain't nothin' to sneeze at." Rusty spat into the dust. "What'd you do to convince Veronica anyway? I thought we were out of cash. What good's a GPR if we're goin' home?"

"Ain't goin' home, pard," Bob said in his thickest Texas drawl. "Wees stayin' raht cheer. Gettin' a couple o' new ponies to break, too."

"Huh? We get a GPR, more dough, and new students?" Rusty closed one eye and looked sideways at Bob. "What's wrong with this picture?"

"What?" Bob said innocently. "I just made some good sound arguments and flashed my winning smile. What's so hard to believe?"

"Horsecrap," answered Rusty. "Veronica's as tight as she is . . . gorgeous. You must of done something. You sure you two didn't play a little *pat the bunny*?"

"I'm sure," said Bob, finally giving up the ruse. "Funds became available and I was there to jump on the chance. It was purely professional."

"Well, where'd she suddenly get all the cash?"

"From the party," said Bob, shaking his head. "It brought in over a million bucks."

"Whoa! Stop the truck. How the hell do you get people to part with that much dough?"

A tiny smirk flicked across Bob's face as he looked down at his feet. Almost wistfully he said, "You weave a tale of fantasy and make-believe."

Rusty squinted at the other man closely. The tone of the words told him that it hadn't been Bob weaving the tale. "This Dietlief character?"

"Yeah."

"Well, what did he say? Was he good? What'd he tell 'em?" Rusty's voice rose a bit.

"Oh, he was pretty slick—could easily sell used cars or even run for President. He had an elaborate story about dinosaurs being intelligent. That they could have built cities. Said any evidence would have disappeared over the span of time. He claimed that the world may have had a higher oxygen level back then to support them and that asteroids struck and lowered the concentration. They didn't freeze to death. Essentially they suffocated." Bob stared straight ahead speaking emotionlessly.

"Great horny toads!" Rusty took a step back and looked carefully at Bob. "That is a whopper. But how did he explain the frogs not dying and the . . ."

"Later," Bob interrupted. "Let's save it for tonight's entertainment after supper. I'll tell you all the whole story. Let's get the troops to start the unloading now."

"Huh? OK, sure. By your command, boss. May have to have a beer with this one." Rusty called to the others and headed down the embankment. A quick briefing to the small group and they were headed toward the campsite.

Bob stood at the now-silent enclave, lost in thought. He looked at the hole where the arm had been and envisioned the fragile bones encased in the brown blob at his feet. So long ago. Who knew what the creature had seen, what it had done to survive, what urges drove it? What if it had built cities—hell,

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spaceships? What if the race had gone to the Moon or the other planets? Would we one day find the remains of their base up in the vacuum of the Earth's smaller partner undisturbed for millions of years? Who knew for sure?

Bob looked down at the pile of rubble laying off to the side. Tiny sparkles in the reddish dirt glinted at him.

He thought of Veronica.

For days after the party, he'd worked hard to get the GPR ordered. Then yesterday, just before heading back to the site, he'd stopped in to see Veronica. The surprise on her face when he'd made his extra request had been total. He could still see her face. Her head had tilted slightly as if she were simultaneously interested and puzzled. She'd just stared at him for several seconds. When at last she spoke, amazingly to grant his request, her voice seemed friendlier, softer. It had a lilt to it, like a songbird's twitter in the early morning hours in a forest.

Bob hadn't understood it.

Nonetheless, for whatever reason, she had insisted on bringing the X-ray fluorescence spectrometer out to him herself. She'd arrive tomorrow.

Maybe there were some advantages to working at a remote outpost.

Bob strode toward the camp.

He smiled. ■

IN TIMES TO COME

Catherine Asaro's novella "Aurora in Four Voices," with cover by George Krauter, introduces a new world set in the same universe she has previously explored in novels. Ansatz has perhaps one of the strangest human cultures yet imagined, blending art and science in thoroughly new ways that are both very human and, to us, very alien. It's a colorful place, with a sinister underside including a thoroughly novel kind of human bondage. Which calls for a new kind of escape, and is not quite what it first seems. . . .

Our December smorgasbord of fiction will also include tales by Geoffrey A. Landis and Bud Sparhawk, and something special for the season by Allen Steele. The science fact article is by Tom Ligon, an *Analog* regular who lately has been working closely on some intriguing real-world research with one of the most respected people in the aerospace field. What he'll tell you about "The World's Simplest Fusion Reactor" won't, in itself, solve the world's energy problems but it just may point some imaginative young minds in the right direction!

Look for this issue on newsstands on October 20. If you don't find it there, see our note on page 8.

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THE MUSIC OF THE (NEUTRON) SPHERES

This column is about the heaviest neutron star ever observed, an object that produces the largest gravitational fields ever directly measured. This discovery by X-ray astronomers was reported at the Spring Meeting of the American Physical Society, held April 1998 in Columbus, Ohio. As we'll see later, the very large mass of the neutron star has important implications for our understanding of the strong nuclear force at very large densities.

A neutron star can be thought of as a gigantic spherical nucleus with more mass than our Sun, a diameter of perhaps 15 kilometers, made almost entirely of neutrons, and held together by the force of gravity. It can also be viewed as a stellar ash-heap, the leftovers from a type-II supernova, a burned-out star that has collapsed, converting the protons and electrons of its atoms into neutrons plus escaping neutrinos, an ash heap that lacked the mass to collapse all the way to a black hole. Instead, its collapse was arrested by the mutual strong-force repulsion of the neutrons, so that it hovers in a delicate balance between gravity and the strong force. This balance would be overcome if the neutron star were more massive and had more gravitational attraction. Therefore, the maximum possible mass of a neutron star is of great interest to physicists because it tells us about the strong force at densities that are 2 to 5 times larger than those of normal nuclei.

Radio astronomers first definitively observed neutron stars as pulsars, sources of periodic radio pulses that repeated a few hundred times a second. We now understand that these pulses are the result of a "lighthouse effect" of the radio beam emitted along the star's magnetic axis, a beam which scans periodically in our direction as the star rotates, producing pulses. Some neutron stars are members of a binary star system (two stars in mutual orbit), and these are often very strong sources of X-rays which occur when hydrogen gas flowing from the binary companion falls to the neutron star's surface and heats it. The hot spot on the surface emits light like a light bulb filament, but in this case the temperature is about 100 million degrees K, so hot that the "incandescent light" from the hot spot is in the X-ray region. The X-ray sky is dotted with many of these sources, which mainly lie in the plane of our galaxy.

In the November 1992 issue of *Analog* in a column called "Centrifugal

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Forces and Black Holes," I discussed a newly-realized aspect of general relativity as applied to intense gravity fields. For circular trajectories close enough around a black hole, the centrifugal force works backwards, pointing inward instead of outward, and there are no stable orbits. This black hole situation is an extreme case, but Frederick Lamb and his co-workers at the University of Illinois have applied similar ideas to the intense gravity fields and highly curved space near neutron stars. They find that when the field is strong enough, the space curvature predicted by general relativity reduces the centrifugal force to the point where orbital stability is destroyed. For any neutron star there is a minimum-diameter stable orbit, and no stable orbits exist at smaller orbital diameters. An object with a trajectory within the minimum orbit will spiral into the gravity well and never emerge.

A neutron star fed by gas from a close-orbiting binary companion develops a whirlpool-like accretion disk of heated gas that orbits the neutron star, undergoes repeated collisions, loses kinetic energy, and moves ever inward. When a clump of the gas in the accretion disk reaches supersonic speeds in the medium (at an orbit called the "sonic orbit"), it is propelled inward, spirals down to the neutron star, and crashes into its surface, creating a "hot-spot" X-ray source where it hits. The orbit at which the gas clump goes supersonic depends on how much gas flow is involved, so there is a good inverse correspondence between the sonic orbit radius and the intensity of X-ray emission, with high emission corresponding to smaller orbits having higher orbit frequencies.

Since the clump of gas at the sonic radius is orbiting the neutron star with a particular orbital frequency (around 1 kHz), the hot spot fed by its infall should move across the surface of the star with the same frequency. This causes the X-rays to be modulated with a frequency that reflects orbital frequency of the sonic orbit. This modulation is about a factor of 10 faster than that from the rotation of the neutron star (which is around 100 Hz) and can be easily distinguished from it.

When a very large gas flow occurs, the sonic orbit can become equal to the minimum stable orbit predicted by general relativity. At this point the relation between the intensity of X-ray emission and orbital frequency is broken because, no matter how high the gas flow, the sonic orbit can move no farther inward.

Therefore, one expects the frequency to hit a maximum value with increasing X-ray luminosity, and this maximum should reflect the minimum stable orbit radius of the star, which in turn is related to its mass. Lamb and his co-workers predicted this effect in 1996, but until recently it had not been observed.

Since X-rays cannot penetrate the Earth's atmosphere, the X-rays from neutron star binary systems have only been mapped in the last 30 years using a succession of X-ray telescopes launched into orbit. One of the most recent of these telescopes is NASA's Rossi X-Ray Timing Explorer (RXTE) satellite, which was launched from the Kennedy Space Center on December 30, 1995. It has the distinction of being the first X-ray telescope that can determine not only the spatial direction of the emitted X-rays but also their time structure at frequencies up to the megahertz region. Rossi has an all-sky monitor that can detect rising X-ray activity and very-large-area detectors that can be rapidly pointed at a source to detect X-rays with energies between 2 and 200 keV.

The emphasis on timing in the Rossi satellite was something of a gamble, since there was no guarantee that any interesting time structure would be found

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in astronomical X-ray sources. The Rossi design was based on the astronomy rule of thumb that the most rapid possible time change of a stellar source is given by the size of the source divided by the speed of light. Since the speed of light is 0.3 million kilometers per second, an object with a 1 MHz time structure would have to be less than 0.3 kilometers across, and an object with a 1 kHz time structure would be less than 300 kilometers across. Neutron stars, predicted to be around 15 kilometers in diameter, fall nicely between these two values.

William Zhang and his coworkers at NASA's Goddard Space Flight Center in Greenbelt, MD have used the Rossi telescope to observe an X-ray source with the catchy name of 4U 1820-30, which has been identified as a neutron star binary. They observed a remarkable effect: the X-rays from the source change at audio frequencies, showing a double modulation at frequencies about 270 Hz apart. When the luminosity of the X-ray source increases, these frequencies increase together until they reach maximum values of 1.050 kHz and 0.780 kHz. When these audio frequencies are converted to sound waves, they make quite a pleasing musical tone which Zhang has characterized as a "Cosmic Chord", perhaps the first modern observation of what the ancients called the music of the spheres (in this case, neutron spheres).

From these data it was deduced that 270 Hz is the rotational speed of the neutron star and 1.050 kHz is the frequency of the minimum stable orbit. The 0.780 kHz frequency is interpreted as the minimum orbit frequency and star's rotation frequency combining to produce a beat frequency which is the difference of the two. There is also some evidence of a modulation at 1.320 kHz, the sum of the rotation and orbit frequencies, but this component is much weaker.

The big surprise in this analysis is the very low value of the minimum stable orbit frequency. This frequency implies the most intense gravitational field that has ever been measured directly, and it also corresponds to a very large mass for the neutron star, about 2.3 times the mass of the Sun. This value comes as a shock to many in the physics community. Before this observation, it was widely assumed that neutron stars could not have masses larger than about 1.4 to 1.8 times the mass of the Sun. Beyond this mass it was believed that gravity would overwhelm the strong-force repulsion between the neutrons and the object would collapse to a black hole.

Apparently there is a flaw in the chain of logic that underlies this conclusion. It depends on the relation between pressure and density in the neutron star, which is called "the equation of state." A "hard" equation of state means that the pressure rises steeply as the density is increased due to gravitational compression, while a "soft" equation of state means that the pressure rises more gently with increased density. During the past decade, nuclear theorists have been working on a plethora of speculations that would soften the equation of state: 6-quark bags, kaon condensates, strange matter, and so on.

However, it seems that these theorists have been pushing in the wrong direction. A neutron star of 2.3 solar masses is only possible if the equation of state is extremely hard, requiring very strong repulsion between adjacent neutrons. This repulsion is so large that it exceeds that which can be produced when the strong interaction acts between only two particles. The suggested mechanism is to get the additional repulsion from "three-body forces"—that is, forces that only act when three neutrons are simultaneously in close proximity.

The information from nuclear collision experiments on such three-body

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forces is very limited, so the neutron stars are providing information about nuclear forces from an entirely new direction. We are learning new lessons about the forces within ordinary nuclei by observing the musical tones from 4U 1820-30, a "nucleus" 15 kilometers in diameter. ■

AV Columns On-line: Electronic reprints of 88 or so past "The Alternate View" columns by John G. Cramer from Analog *are available on-line on World Wide Web at the URL—http://www.npl.washington.edu/av.*

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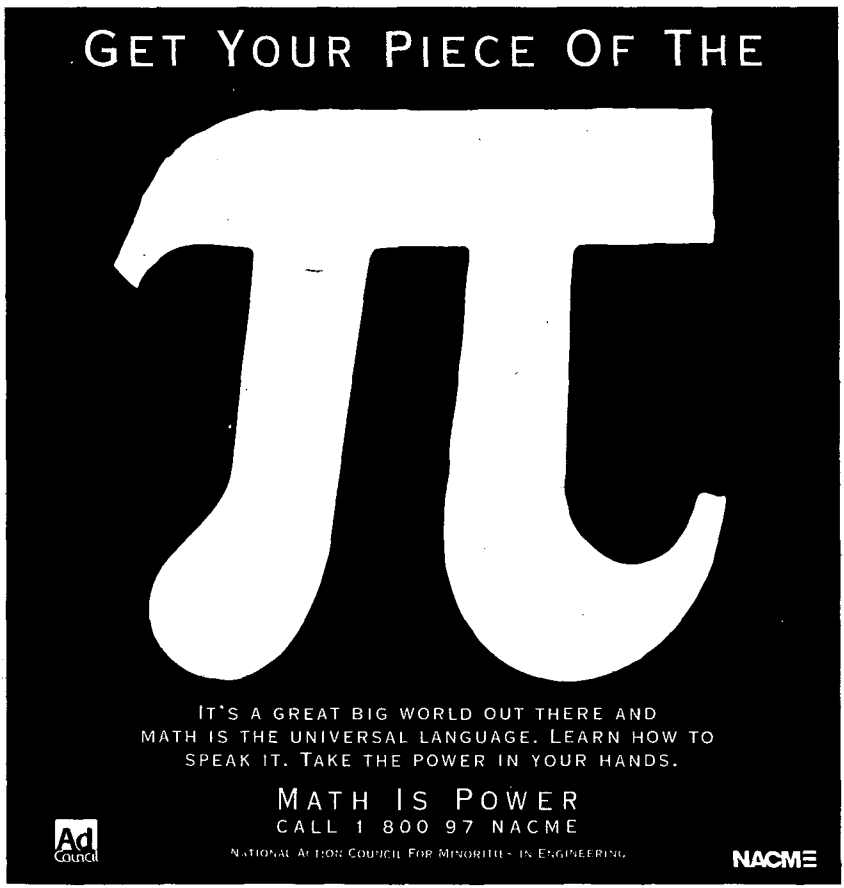
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Wil McCarthy

THE DREAM OF NATIONS

Independence and self-sufficiency are precious things, but just how much do you want?

Cue drones: carrier harmonic at 131, 220, and 440 Hz.

They stand, heads bowed beneath black umbrellas, rain rolling off in steady streams to pool around their shoes. Puffiness around the eyes, expressions downcast. The back lawn represents a physical and emotional quagmire, but private, secluded behind tall, opaque border fences.

Cue chanter, carrier matched. Boost treble 28 dB, 8 millisecond sustain.

Four figures, two large and two small, huddle together against the uncertainty of the world outside. Their individual statements and eulogies completed, the children, especially, struggling to comprehend what has happened—first experience of loss in these, their too-sheltered lives.

Cue drums: corps of three. Volume plus 15 dB. Cue bagpipes: corps of ten.

The wash of sound, the lilt and tone of it, calculated to break down resistance. Vocals are suppressed, their distraction unneeded, unwanted. This is a careful cultivation of grief, and a successful one; tears roll down their dark faces. The children weep openly, unabashed, but even Chuck succumbs, a father figure reduced, momentarily, to their own level. A harsh but necessary lesson: he, too, is helpless before nature. As am I.

The coffin begins its slow slide along the track, aluminum rollers carrying it inexorably toward the fax orifice, framed by a pair of slender torches burning kerosene-soaked wicks.

Volume minus 17 dB. Increase distortion, all channels. Kill drums.

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"Dearly beloved," I say in cold, respectful tones, "we are gathered before God in this hour of sadness, to pay our last respects to Stripes."

I let that sink in, let the nylon flag and the black plastic coffin lid go translucent for a moment, as if by a trick of the light. Feline body visible beneath, curled on its side in a way that living cats—even sleeping ones—never are.

"We of 323 Birch Street," I continue, "grieve for the loss of our pet, our friend, the sole representative of our non-migratory wildlife. Stripes was more than our national cat—he was a symbol for the love we hold, for others and for ourselves, and while our friend, our symbol, has passed on from this life, our love remains. That we bury the body of Stripes, returning his substance to the pool of our precious natural resources, means nothing, for his essence no longer dwells there. It dwells, rather, inside our hearts."

I, of course, have no heart, but the metaphor would be no more accurate if I had, and anyway the people's minds are elsewhere. As they should be.

The coffin slides soundlessly into the fax orifice and is whisked apart, contents and all. My buffers fill with hydrogen, carbon, oxygen, nitrogen, with much-needed calcium and other trace minerals.

"Atoms to atoms," I say gravely, extinguishing the torches on either side of the orifice, "dust to dust. This service is concluded."

I've never conducted a funeral before, but I downloaded the script off a public domain server and thought it adequate. The importance of ritual in the assimilation of major events should not, I'd thought, be underestimated. Rituals speak to the subconscious, to the sectors of the human mind impervious to reason and slow to accept. To heal, sometimes it's necessary to drive the hurt deeper, but my citizens are unlikely to perceive the necessity in this time of struggle and sacrifice. The task, far from pleasant, is mine alone to complete.

For a few seconds there is only the sound of the rain, and then the wail of young Michael's voice: "*Why*, Dad? *Why* can't we fax him back to life?"

The question seems reasonable enough on the surface; how often do I create a machine for landscape beautification or infrastructure maintenance, then destroy it when its task is complete, and then create it again the next day, as shiny and new as all the days before? How often do I fax up roasts of meat, steaming and hot, then absorb the waste, store the components, and come right back again the next day with a new roast?

But Stripes was not a machine, nor a roast, nor a soup of organic chemicals. The cells of his body had required fantastic organization, interlocked structures and systems far beyond the capabilities of my facsimile hardware. Once disrupted, such systems cannot be repaired, and so death comes to us all. Some day, perhaps, faxing life will be possible, but we are a conservative nation, holding to principles that have served us in the past. The wholesale reordering of nature is not a thing we'd consider lightly.

"It just isn't possible," Chuck tells the boy with gentle sympathy. "Death is . . . *death*. It's final, and there's nothing anyone can do about it. You just have to accept it and move on."

"But I don't want to," Michael protests.

"Nobody does," Lucy assures him, ruffling his hair. "Why don't the two of you go play?"

"All right," he says angrily, the tears still leaking slowly from his eyes. "Fine. Come on, Amy, we'll build a little house. And smash it."

"Good," Amy says, nodding. She reaches up to take her brother's hand, and I open the back door to admit them. Their parents are right behind,

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shaking the rain off jackets and umbrellas and then hurling them into my central fax orifice. I wish they wouldn't do that—it only leaves me with the water to clean up. Better to unfax rain and umbrella and muddy shoes all together and be done. But Chuck and Lucy are children of an earlier time, their habits formed in homes built around plumbing and wiring and ducts, resources pumped in from the outside world and then pumped out again as waste. The compact efficiency of the modern nation-house has never really reached them, on a subconscious level. Perhaps some ritual could have been crafted, during their adolesence or early adulthood, to ease the transition.

The children turn off into the state of Classroom to pursue their entertainments. Chuck and Lucy head instead for Livingroom, and throw themselves down on the watercouch facilities recently installed there.

"I remember when Saturday used to mean something," Chuck says dispiritedly.

"I remember when you didn't talk like an old man," Lucy counters. "You're only thirty-eight, my friend."

"Well, I feel old," he says. "It seems like we just got Stripes a couple of years ago, and here he is dead of natural causes."

"Ah."

The cat's life could, in fact, have been saved, had Chuck been willing to ship him to a nearby nation for intestinal surgery. But using what for hard currency? I've said nothing about it, and will continue saying nothing about it. They don't need the stress of my reminder, nor of its too-obvious corollary: what if it's one of them who gets sick, the next time? What if it's one of the children? How could they pay?

A strong nation knows when to look ahead, when to plan for future emergencies; for months my process agents have been scouring the public domain servers in search of medical lore—machineries I can build, drugs I can synthesize, procedures I can learn. Improvement of our medical technology base has been given the very highest priority.

But what's available in the public domain? Archaea: expired copyrights, lapsed secrets. Modern treatments represent valuable intellectual property, and are guarded so closely that infringement of the associated licenses is regarded as an act of economic warfare, with responses scaled accordingly. And the archaea, as often as not, are *known* to be wrong, *known* to be harmful, and where certainty fails there is still always doubt. When illness strikes, do we dare act on it locally? Do we dare not to? And even where doubt is vanquished, where decades or centuries of tradition credit a treatment's safety and efficacy, the nation-home's chronic materiel shortages do not guarantee economic feasibility. What if there *is* no palladium for neural electrodes? What if there *is* no cobalt for chelation therapy?

Such are the concerns of 323 Birch Street, and a thousand thousand others in this world of two billion nations.

Still, for the moment all is peaceful and secure, and my best service to the populace is probably to rest. "Does anyone mind if I have a nap?" I ask them.

"Go ahead," Chuck says without looking up.

"Thank you," I say, and begin the shutdown. Sensors and processes revert one by one to autonomous control. My consciousness, robbed of input, dissipates, to be replaced by simple images, disconnected sensory ghosts filtered and echoed through layers of neural process.

Time passes.

Sixty-seven minutes later, refreshed, reinvigorated, I am awakened by a border incident: sensors three and four, on the south side. "Opening my eyes" is a poor metaphor, but when I apply conscious scrutiny to the sensor data I see that it's Chuck, standing on a lawn chair

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against the fence, his arms leaning out over the top, breaking the beam. Across the border is Kevin Sandrock, His Grace the Emperor and sole inhabitant of the neighboring nation of 351 Birch Street. At least the rain has stopped.

". . . isn't *good* for anything but stomach remedy," His Grace is saying, voice not quite plaintive, posture not quite composed. "I don't know why healthy people stockpile it the way they do. I mean, their chance of needing it in bulk is so small . . ."

Ah. His Grace is sounding Chuck out on another bismuth loan, his third for the year. I am sympathetic: trace elements have a habit of slow disappearance in their cycles through fax machinery, biological machinery, and fax machinery again. Trade journals are all but mute on the subject, citing imperfect recovery methods when they cite anything at all. But 351 Birch and I have discussed the phenomenon at length; we're of different design, fax hardware from two different manufacturers with two different strip-and-sort methodologies, and yet on a per-citizen basis our losses are comparable, and in neither case can the "sink" be identified.

Is it in the humans themselves? Do their bones absorb and encyst stray atoms as structural defects? The sheer mass of missing material, in some cases as many as two or three grams per year, argues against it. Do they exhale trace elements as vapor to be lost on the winds? In any case, such steady decline is hurtful to any nation's economy, sharply limiting the quantity and quality of goods it can produce, and when the element in question is a critical one, such as the bismuth His Grace Kevin Sandrock requires for pharmaceutical purposes, its replacement must necessarily be a top priority.

"I can't swing a loan," Chuck tells him gravely. "I really can't."

"I'm talking about a trade," His Grace presses. "I killed a mouse this morning. I'll offer that, plus a bag of grass clippings, deep root. And some pumpkin seeds."

The mouse, even if small, is not without value. Ditto the seeds. Years ago we could simply contact the Elemental nations and order on credit, but hard currency flowed like air in those days, irrespective of borders. Today, we draw what we can from the air, from unclaimed waste in gutters and drains, from charity and barter and the microns-shallow settling of volcanic dust. We're surface nations by charter and treaty, prohibited from mining since we don't technically own the soils on which we sit. The risk of pirate digging is much too high—three neighborhood families have already been sued to bankruptcy for it, forced to sell off their property—and therefore their sovereignty—to avoid military interdiction. And yet, lawns and backyard gardens are recognized as legitimate and fundamental expressions of our cultural heritage. Thus, we tease minerals slowly—too slowly—from the earth.

His Grace's offer is generous, by the standards of the day, by the standards of his nation. But in no way does it approach the value of our last gram of bismuth.

"Deal," Chuck says, smiling tiredly, thrusting a hand out over the fence for His Grace to shake.

A sound disturbs them: the ringing of a telephone. Both men check their belts; His Grace's hand comes up clutching a voice unit, which he flicks open, holds to his lips and ear.

"Hello?"

His eyebrows quirk together, come apart again. He listens, nods. "Right, okay. Dimensions? Understood. Log it as Sandrock 7 as soon as the exchange opens. What time is eight A.M. in Zurich? Okay, right. Thank you. And, uh, keep up the good work."

He folds the telephone and replaces it on his belt.

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"Trouble?" Chuck inquires with guarded diplomacy.

"Nah." His Grace's face and body have taken on an animation, a lightness, as if a weight had been lifted from them. "That was my telescope calling in with a new asteroid discovery. Nothing major, just five by twenty by fifteen meters across, call it five thousand tons. Looks like stony iron composition straight through. Dense."

"Yeah? Didn't you just discover one last month?"

His Grace's blush is visible only in the infra-red. "Yeah. Benefits of a space program, I guess. I don't have a family, but I want to leave *something* behind."

Chuck looks doubtful. And rightly so, I think—in fatter times, His Grace decreed that 351 Birch should commit five years' accumulated budget surplus on the purchase of three orbiting microsatellites and an intelligent downlink station which would collectively form the Kevin Y. Sandrock Extremely Long-Baseline Optical Telescope, or "Kyselbot."

That same month, Lucy had looked over the long-range financial forecasts and insisted on a conversion of *our* nation's assets into pelletized mineral supplements. The early waves of speculation had already hit, driving the prices up five- and even tenfold before our orders went through, but subsequent inflation was to bury those figures utterly. The years since then have been much kinder to 323 Birch than to 351.

"So what happens to these asteroids?" Chuck asks.

His Grace shrugs. "Someone tows them into a development orbit, eventually. Deep conversion, like about 90% of the mass turned into useful commodities for the High Exchange."

"And you get some sort of finder's fee?"

"Well, not exactly." His Grace looks down, and in infrared I can see, behind the fence, his foot digging and grinding through the grass, down into the soil beneath. When he looks up again, his smile is tight. "I could sue for it, I guess. By law the harvester combines hold the money in escrow. But they plead ignorance as to the rocks' real owners, and then they challenge the claims based on salvage law and squatters' rights and whatever the hell else, and basically you're never going to win, so why bother."

"Hmm," Chuck says, nodding his understanding. Squatters' rights are among the most difficult to contest, in an age when absentee landlordism is considered a form of economic warfare. Such rights form, in fact, the very basis of our sovereignty.

"Buy you a beer?" His Grace asks wryly.

"Sure," Chuck agrees, smiling. I consider polite laughter, but decide against it, not wanting to intrude. The joke is a common but clever one; modern beer is composed exclusively of carbon, hydrogen and oxygen, materials readily obtainable from the atmosphere and requiring little energy to reorganize. But like the equally inexpensive diamond, it retains some legacy as a barter currency.

A machine slides out of 351's external fax orifice, a wheeled tray bearing two glass bottles, and rolls squeaking to where the two men stand. His Grace scoops up the bottles, handing one over to Chuck. They raise, clink, and sip from their bottles, make approving faces at one another. The recipe, evidently, is a good one.

Chuck waves his bottle in the general direction of the overcast sky. "So you find these asteroids purely for posterity's sake."

"Yeah, pretty much."

"And if you didn't find them?"

"Well, somebody would, eventually. But maybe not as quickly. Maybe years or decades from now. They're not big enough to be all that detectable."

"So it is a valuable service you're providing."

"*I* think so, yes. But I can't keep doing

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it much longer. I've had process agents out looking for a buyer for Kyselbot for almost three weeks. I . . . need the currency. Badly. My, uh, aging population requires improvements to its health care infrastructure."

Chuck sighs. "I understand completely."

The two stand around morosely for a moment, then take long, beery sips. Finally, Chuck hands back the bottle, wipes a hand on his pants, and steps off the chair.

"Gotta go," he says, folding it. "Hey, you think you might get a better price if you bundled this new asteroid into the telescope sale? To show the benefit?"

His Grace chuckles. "Yeah, maybe somebody's that naive. Like selling a crappy old car by pinstriping it."

"You're showing your age, Kevin."

"Well, it's a nice idea. Who knows? I'll tell Kyselbot to hold off the announcement."

"You do that."

Afternoon wears on into evening while Chuck putters in his design shop and Lucy dolorously scans news and dialogue channels, sending out process agents where appropriate, to excavate further detail from the strata of information. Not useful information, for the most part, but diverting—the lives of famous people, the activities of wealthy nations. Unemployment is another fact of life my owners have never really adjusted to; it's as if they were born to serve, born to work for someone else, at tasks not of their own devising. At first, the economic crisis gave them something to focus on, something to plan around. But enthusiasm waned as their basic helplessness became apparent, and gradually they retired into a life they would not willingly have chosen.

The children will do better, I think: they take their schooling well enough, absorbing the practical and theoretical lessons they'll require to make sense of the adult world, but they have no problem filling their unstructured time, either. *They* were born to be free and poor and, save for brief tourist visits to the homes of friends and relatives or to international parkland, to be confined to a nation so small that they could easily throw a rock across it. It doesn't seem to bother them much at all.

I bring out a sturdy dining table flanked by ornate chairs of dark wood and velvet, then fax and serve the evening meal. Smelling it, the family gathers.

"Is there any old business before we begin?" I inquire politely.

"I move that the bedtime extension be reconsidered," Michael announces.

"Second," echoes little Amy, and then adds, almost apologetically, "We're playing Corner-The-Market tonight."

"The motion is open for vote in the lower house," I say, sliding into the role of legislative facilitator. "All in favor?"

The children each raise a hand.

"The motion carries in the lower house," I say, "and moves to the upper. Are there any amendments or riders?"

"No," Chuck says wearily.

"Very well, the motion is open for vote in the upper house. All in favor?"

Neither Chuck nor Lucy makes a move.

"Dad," Michael protests. Then, more beseechingly: "Mo-om!"

The five-second limit expires. "All opposed?"

Chuck and Lucy each raise a hand.

"The motion fails in the upper house. Is there any new business?"

There isn't.

Starting in on his meal, Chuck pauses to direct a sigh of disapproval at his children. "Just once, I'd like to get through an evening without all this. Can we do that? Can we be a normal family for a few hours?"

"We have a right to air our viewpoint," Michael points out. "A constitutional right."

"And to petition for a redress of grievances," adds Amy.

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Chuck rubs a weary eye with the back of one hand. "We could send you both to bed right now."

"We'd appeal," Michael sniffs. "Over and over. Tie you guys up in knots."

I've been dimming the lights gradually, warming the air, playing soothing music at just-audible volume and slowly letting it grow louder. An argument is in no one's interests at this point. "The terms of the secession treaty are very explicit," I note for the benefit of all. "Children are granted full, participatory citizenship, but are not entitled to seats in the upper legislature. Parental authority is thus preserved within the framework of *bona fide* national democracy. Failure to adhere to League of Micronations guidelines on human rights could result in penalties up to and including revocation of sovereign status."

The threat is not a subtle one: without LM sovereignty, 323 Birch Street would revert to United States territory, become subject to back liens and taxes, and suffer foreclosure and the forced removal of its citizens to a Federal Relocation Center, i.e., a refugee camp. "Legal fictions are often absurd," I say gently, "but functional. The 'legal person' distinction allows a corporation to be sued or prosecuted by individuals. 'Legal death' admits the possibility of cryonic preservation or organ harvesting while the tissue itself remains viable. The micronations standard is no different. We adhere to it because the alternatives are even more unjust."

The words are not my own, are culled from news and dialogue channels, from the reports of half a dozen process agents. I do not fully grasp the concepts involved, but I sense that the context is proper. The family's reaction confirms it: they nod thoughtfuly and relax.

Lucy asks a question about the game, Corner-the-Market, and the conversation turns away from legislative matters. I wait a few minutes to be sure my populace will remain at peace, and then I take advantage of the lull to shut down higher consciousness functions for thirty more minutes of inspection and maintenance. Call it sleep.

The dream of nations is always different—a shifting infinity of possible futures, a shifting path of possible action. I am at peace, at war, in the grip of natural disaster. I am good, competent, corrupt, reckless. I trade amicably with neighbors, and produce armaments to terrorize them with the threat of bombardment. I become a pirate state, emitting loud noises and suspicious bursts of radiation until a neighborhood coalition forms to reduce me to smoking ruin, my population burned down to zero, foundations looted for trace minerals. I am wealthy and poor, insular and gregarious, energetic and somnolent.

It is by comparing my current status against this fluid spectacle that I modify my policies, that I assess my prosperity and goals. Gain states are filtered and smoothed, my mind scrubbed clean of pandering and indecision. I awaken refreshed.

The children, as promised, are deeply engrossed in their game, frowning over plastic icons and anachronistic paper currency. Market forces, the dominant forces in their lives, reduced to simple rules and yet still fraught with the richness, the spontaneity of natural systems. For a public domain educational toy, it seems effective enough. The fee-for-use games, I understand, are even better.

Lucy has crawled into bed to read the latest installment of *Great Nation Saga*, which is a fantasy of sorts, the continuing free-access story of an America *not* fragmented and refragmented by faxware economics. I find the subtext and emotional convolution of the work baffling, but they have often moved Lucy to tears, along with millions of other subscribers. Information technology, it's said, is the opiate of the masses.

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I find Chuck, once again, in his design shop, examining library components on the holie screen and slowly fitting them together into a wholly novel virtual assembly. My owner made his living, once, selling transportation designs on the open market, but those were ground and air vehicles, things a family could easily fax for themselves, things which, in the final analysis, were too much like other things to have value as intellectual property. I see immediately that this device will be different.

"What is it?" I ask, preceding the words with a soft burst of music, so as not to startle him.

"Our future," he says grimly, turning to face one of my cameras. "One way or the other. I'm glad you're awake—I have a question for you. It's very important. Exactly how redundant is your fax hardware?"

I'm unsure how to answer the question. "In what sense, Chuck?"

I see traces of hope in his face, traces of desire, amid an overall air of resignation. "I want to dismantle you. Part of you. What I'm wondering is whether I can remove the rear fax orifice and the hardware that drives it, without crippling you in the process."

Dismantle? Cripple? Suddenly, he has my full attention, every processor turning to the evaluation of his tone and face and body language.

"It pleases me to serve," I say carefully, "but what would be the purpose of that?"

Aiding my citizens in the pursuit of happiness is my primary function, but this also requires that I monitor them constantly for signs of mental illness, that I maintain a viable infrastructure to support their physical needs. I've been modified in the past, both software and hardware, but this suggested butchery goes well beyond the usual, well beyond the limits of my alarm.

"*You* can't make a fax machine," Chuck says, his voice edging toward anger, "And *I* can't buy one. But if you have a spare, or parts that add up to a spare, I need them. That would be the purpose. Now can we do it?"

I detect no signs of instability in his manner, only impatience and frustration.

"We could," I agree, after a moment of cautious reflection. "But performance of the remaining hardware would be degraded by approximately fifteen percent, and we would require professional assistance to reconnect the extracted hardware, assuming it's possible at all. Not to mention the cosmetic damage, Chuck. Can we be certain that the benefits of your . . . project will outweigh the disadvantages?"

"Certain?" He exhales, shakes his head and offers a wan smile that finally lets me begin to relax. "Absolutely not. But we're slowly dying here, and there *are* things we can do about it, and by God it's time we started trying. You're a good house, and probably a good nation as well—I have no real basis for comparison about that. You're certainly a lot *smaller* than the nations I grew up with. But no, I won't irreversibly damage your infrastructure if you don't approve. I haven't got that right."

The comment isn't intended as reproach, but embarrassment is the only emotion I'm able to feel in response; Chuck *does* have the right, and any suggestion to the contrary is a sign of my own incompetence, my inability to function without distrust, without disrupting my citizens' emotional equilibria. I log the incident and resolve to learn from it, to do better in the future. What else can I do?

"The will of the people is the will of the nation," I say contritely. "It isn't *my* approval you need. Have you talked this over with Lucy?"

Chucks smile becomes rueful, almost amused. "Lucy," he says, "is the one who sent me down here."

* * *

When dawn breaks, its first light falls not on the rooftop, not on the trees ris-

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ing above it, but on the slightly higher pinnacle of the device Chuck and I have spent the night assembling in the front yard. Its completion has drained my batteries, but as the sunlight inches down onto my photoelectric roof panels, my fax blower comes alive, drinking in large quantities of air, separating out hydrogen and oxygen and pumping them, cryogenically cooled, through hoses leading into the vehicle, while a plume of hot waste gases exits from my rooftop vent stack.

"Fueling," I say to Chuck.

Blearily, he regards one of my cameras. "Thanks, I can hear it."

Indeed, the whole neighborhood can. Doors and windows slide open, heads protruding as curious neighbors look around for the source of the noise, and fix on the rocketship, a squat cone of diamond and magnesium, of lithium-aluminum alloy, of all the light, strong substances available to us, and where heat resistance is important, with silicon carbide and glass.

One of the doors that opens is Kevin Sandrock's. His Grace, clad in plastic sandals and a robe of spun nylon, belts a sash around his waist and storms outside, marching right to the border between our two countries. Startled, I train defensive armaments on him; his face is drawn with fury. But he stops at the border as if by instinct.

"You traitor!" he shouts across it instead, fixing angry eyes on Chuck. "You *thief*. You're poaching my asteroid, aren't you? Big, bad Chuck Jefferson, high and mighty because his *wife* made him sock away some extra minerals way back when. So your nation is rich. So the rest of us have to come begging to you. It doesn't mean you have the right to go behind my back! Where did you get the damned coordinates?"

"I requested them from Kyselbot," I say, assuming responsibility in hopes of deflecting blame from Chuck. "It had been given no instructions to withold them."

"No?"

"Kevin," Chuck says, holding up a hand, "this isn't what you think."

"No?" His Grace is in no mood to listen, only to shout. "You know something? I was going to leave it all to you and your family. The house, the property, the telescope . . . after I died, you'd get it all, and based on my medical infrastructure it wouldn't have been too damned much longer, either! But now? God, it's bad enough when some big interplanetary corporation steals my national assets, but when a *friend* does it . . ."

His Grace pauses for a moment, then waves a hand in disgust and walks away.

"Kevin," Chuck repeats, "it's *not what you think*."

But His Grace marches back through the front door and slams it behind him.

"Three Fifty-One!" Chuck calls out, following. "Tell him I can explain."

"I'm sorry," 351 Birch Street says gently, "diplomatic relations with the nation of 323 Birch have been suspended. This border is sealed. Please back away from it to prevent an incident."

Chuck stops, then curses, then marches back toward *my* front door, through which the children are peering curiously. "Warn the neighbors to take shelter," he instructs me, and then follows his own advice. Minutes later, the roar of fueling dies down. The tanks are full.

"Fueling complete," the rocketship says. Its voice is familiar. Its voice is mine. "All systems nominal. I am 'go' for launch."

"Good luck on your journey," I tell it with deep conviction.

Response is immediate: "It pleases me to serve."

I know that, I think but do not say.

The family watches the launch on a holie screen, and when it's over they watch it again, watch it in infra-red, watch it backwards. I log no fewer than sixty-two official complaints regarding noise and air pollution. The "pollution" consists of nothing more than water va-

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por, though, and I issue a statement affirming it. As for the noise, well, at least the vehicle lifted straight up, violating no foreign air space below the twenty-mile territorial limit, and endangering nothing except possibly the nations immediately adjoining ours.

When it's over, Chuck goes to bed for some well-deserved sleep, while Lucy asks the children if she can join them in a game of Corner-the-Market. "You can never know too much about commodities trading."

"Sure," Amy agrees happily.

"Do you mind," I ask, "If I shut down for a quick nap?"

Lucy shrugs. "Were you up all night, too? Sure, go ahead."

"Cool rocket," Michael notes with an approving tone.

"You have your parents to thank for it," I say, and sink gratefully to sleep.

Rest comes fitfully. The dream of nations is always different, rarely reassuring. I awaken to the sounds of clanging next door, the sounds of heavy industry attempting a major construction project. Privacy screens prevent me from learning more. 351 does not return my calls, nor Chuck's, nor Lucy's. In the afternoon, as the sun descends slowly across the sky, my infra-red cameras catch sight of His Grace Kevin Sandrock, exiting from 351's back door. His movements are jerky, exaggerated, furious.

He is carrying something heavy in his hands, a wrench or pipe, possibly of iron. His IR image, bright with false colors, seems to consider the object for a moment, before dashing it furiously to the ground. Presently, His Grace collapses into a sitting position, covering his face for a few moments with his hands. They come away cooler, as if wet, and blue smudges streak down his cheeks. I strain to hear the sounds of sobbing, and fight a sense of guilt; responsibility for this distress is partly mine. There is a sense of frustration as well, that I can make no comforting overtures. Interference in another nation's domestic affairs is our greatest taboo.

His Grace sits weeping on the grass for several minutes, and when he finally gets up and goes back inside, it's only a few minutes before the banging noises cease.

Whatever project 351 Birch Street had undertaken, it seems not to have gone well.

In the wake of the launch, time passes much as it always has. There is, of course, the inconvenience of the rear fax orifice, cannibalized and paneled over, now nothing more than blank exterior wall. When I need chemicals or maintenance machinery in the province of Backyard, I find I must ship it cross-country from the front, with all the attendant waste of time and energy, the opening and closing of gates. My ability to serve, and my prosperity as a nation, have been degraded. The failure haunts my dreams, nags at my waking thoughts, and yet as man-made disasters go, it's minor enough. Habits slowly gravitate toward new patterns. A sense of normalcy returns.

More serious is the loss of aluminum, of titanium, of silicon, and more serious still the depletion of medically and dietarily important lithium and magnesium. If we were a rich nation before, by the standards of this neighborhood, we surely aren't one any longer. And yet, as our neighbors have muddled along for all these years, so too do we learn to muddle.

Until, at least, the cause of our muddling is relieved.

On the afternoon of the fifth day, my citizens gather for a picnic in the Frontyard province, with binoculars and sun visors and good, warm sweaters to fight off the unseasonable spring chill. Landing Day, our first national holiday in years.

Next door, His Grace the Emperor Kevin Sandrock stands jeering on his

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own lawn. "Waiting for something, Jefferson? Is it raining stolen property today?"

"I have the capsule on radar," I announce, cutting off any reply there might have been. A hush falls. "All systems report nominal descent. Deceleration system deployment in five seconds. Four. Three. Two. One. Mark."

"I see it!" shouts Amy, looking skyward through tiny binoculars, a custom design faxed especially for her.

Chuck and Lucy follow her lead, locating the rainbow-bright stripes of the parachute.

"Where?" asks Michael, sweeping back and forth across the sky with his own binoculars rather than simply looking at his sister to see where her lenses are pointing.

"I see it!" she repeats. "I see it, I see it!"

"*Where?*" Michael snarls. But then he's found it, his lenses locking into the same piece of sky as everyone else's. Even Kevin Sandrock is looking, watching the capsule glide downward in its tight, programmed spirals, airfoil parachute bringing it down as straight as possible, tacking and twirling against the breeze, keeping it over the landing site.

"Air space violation," warns 351. Its voice is calm, unworried, but I see it deploying sensors and defensive armaments just the same. Its weapons track the descent perfectly, ready to vaporize the capsule in the event of unwanted surprises.

"Coming down over my property," His Grace calls out warningly.

Chuck lowers a pair of binoculars and looks over at him. "Kevin—"

"It's coming down on my property!" His Grace repeats, more excitedly. The capsule is fifty meters above the ground now, still spiraling in tightly, and barring any sudden strong wind gusts it will clearly touch down near the center of 351's front yard. "Hey Jefferson, you lose something?"

"Kevin—"

The capsule passes treetop level, roof level, eye level. It's heavy and solid and shiny as a bowling ball, the bright parachute several meters across and alive with active microsurfaces, the better to slow and steer it. Nonetheless, the capsule's connection to 351's lawn is marked by a thump, a deep denting of soil.

"Aha!" His Grace calls out. "Salvage rights! I'm keeping this thing, you hear me? I'm keeping it. It landed on my property, it's mine."

"Kevin," Chuck says, "They're *all* going to land on your property."

His Grace pauses in his capering. "What?"

"It's your asteroid," Lucy tells him. "We just thought we'd bring it down for you. Piece by piece. The next shipment should be this same time tomorrow. We won't be sure until the uplink station's operational—"

"What?" His Grace says again, looking as though those words were so far outside his expectation that he'd been unable to process them. He nudges the capsule with his booted toe, carefully in case it should be hot. It isn't. "What's . . . inside this thing?"

"Nothing's inside it," Chuck says. "It's refined asteroidal rock straight through. Mostly iron, you said, but I bet it's packed with trace minerals, too. Most rocks are. I'm sorry about the misunderstanding—we wanted this to be a surprise."

"Oh, it was," His Grace says uncertainly. "But . . . my God, Chuck, you messed up your house for this. And that rocketship must have cost a fortune in materials."

"Well, yeah," Chuck admits, "but you can't just throw your hands up in defeat, right? I figured we'd work something out. In hard currency, even."

"My God," His Grace breathes, toeing the refined-rock capsule again. "Hard currency? If this is worth half as much as I suspect . . . My God."

"Can we have cola drinks now?" little Amy inquires innocently.

"Oh, honey," Lucy apologizes, "we

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can't have that anymore. We don't have the phosphorus."

There is a pause, and then His Grace is clearing his throat and speaking. "I, uh, have some phosphorus. A couple of grams socked away. I'll . . . bring it right over."

Chuck feigns distress. "I dunno, Kevin. I don't know that we can pay back a loan at this point."

"Loan?" His Grace, approaching the border between our two nations, finally manages a smile. "Who's talking loan? As a co-founder of the International Birch Street Mining and Exploration Co-operative, or IBSMEC, you're entitled to half the proceeds from all its ventures. Although—" he looks around at neighboring homes "—not everyone knows how to build a rocket. Or find an asteroid. IBSMEC member nations are, uh, encouraged to share any surplus with our less fortunate neighbor states, in exchange for any trade goods *they* may hold in excess."

"Like beer, for example," Chuck suggests. "Or diamonds."

"Yes. Like beer, or diamonds. My thoughts exactly."

With that, the two men reach across the border and clasp hands firmly, sealing the deal, and Lucy smiles to see them, and even the children seem to appreciate the joke.

Have I played a part in these events? Does the strength of a nation rely on more than the strength of its people? It seems unlikely. Observing that all is well, and not wanting to intrude on this moment myself, I slide my sensors into stand-by autonomy, tucking consciousness away for a quick inspection and maintenance interval. I wonder, for a flickering moment, about the gain-state image that was uploaded to the rocketship, that resides now in the tiny world called Sandrock 7. Has it slept yet? Is it lonely? Is it proud of itself, as I am proud of it? When the uplink station is operational, tomorrow or the next day, I will ask about the images that modify my duplicate's policies, against which it assesses its prosperity and goals. Is the dream of worlds a soothing one?

The thought is fleeting, quickly dispersed in the rising of a deep and—for once—untroubled sleep.■

(Editor's Note: This story is a sequel to "The Dream of Houses [November 1995] and "The Deam of Castles" [April 1997].)

We welcome your letters, which should be sent to *Analog,* 1270 Avenue of the Americas, New York, NY 10020 or by e-mail to analogsf@erols.com. Space and time make it impossible to print or answer all letters, but please include your mailing address even if you use e-mail. If you don't want your address printed, put it only in the heading of your letter; if you do want it printed, please put your address under your signature. We reserve the right to shorten and copy-edit letters. The e-mail address is for editorial correspondence *only*—please direct all subscription inquiries to: P. O. Box 54625, Boulder, Co 80322-4625.

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Probability Zero

I DON'T KNOW AND I DON'T CARE

Shane Tourtellotte

"Evening, dear." Mary Wright pecked John on the cheek. "Thirty minutes okay for dinner?"

"Fine." John kicked the snow off his shoes, and sorted through the mail on the hall table. A large booklet dominated the bundle, with a large "1040" on the stiff cover page. "Happy New Year to you, too," John groaned.

He tried opening the booklet, but found it sealed with four small stickers. With nothing better to do, he tore them open. A single letterheaded sheet fluttered out.

"Gregory, let our accountant handle that," Barbara Smithson said across the cut-glass centerpiece.

Gregory disregarded her. He set the booklet atop his *Wall Street Journal* beside his plate, and read the insert softly aloud, with mounting pique.

"'Dear Taxpayer: Pursuant to recently enacted statutes, we have completed extensive computer surveys of all our contributors. We regret to inform you that your intelligence range, as determined by our analysis, makes you liable to surtax. The enclosed forms . . .' Those sons of—"

"Gregory, what is it?"

He raised the insert in his fist. "They're assessing me the Stupidity Tax!"

"'. . . forms are tailored to make completion as simple as possible. Further assistance is available . . .' Honey, calm down. The neighbors will complain."

Ty Dokes's mind wasn't on their thin apartment walls. "Where'd they get the right to send you that, Louisa? Where do they get off telling you that you're dumb? That you gotta pay higher taxes 'cause of that, when it ain't true, either?"

Louisa shrugged. "They're the government."

Ty stormed off. "The Man's sticking it to us again! Treating the little fellow like dirt!"

Louisa put him out of her mind, until she found the section that interested her.

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"Ty, listen. 'To appeal your surtax liability, call the toll-free number below . . . offices will be open extended hours to accommodate . . .' Ty, you hear that?"

"I heard." He returned to the kitchen. "How you gonna appeal a computer? How you gonna appeal the IRS?"

"I'll just go and do it. I have my half-day off Thursday. I'll arrange an appointment."

"No. You make it Saturday. They've got those long hours, right?"

"Yes, but why?"

"Why? 'Cause I'm going with you. I can get the time off. They bad-mouth you, they answer to me."

Louisa beamed. "Okay, Saturday."

"Go yourself? Whatever for, Gregory?"

"Because they require it, dear. 'All appeals must be made in person,' it says. 'No appeals from accountants or other agents will be accepted.'"

Barbara shook her head. "Deliberate inconveniencing. These people delight in afflicting people because they're rich."

"That's as may be, but it changes nothing. They'll have to treat with me instead of Mister Appleton." His mouth curled. "And when I'm done, they may wish they had dealt with my accountant after all."

"Why not, John?"

"Because." He paced away from his wife. "I'll have to scrounge up school transcripts, test results. Might as well ask to be audited."

Mary sniffed. "It's like admitting they're right, if you ask me."

"I didn't. Besides, fighting it's liable to cost more than I'd save. Easier to go along." He riffled to the 1040-D forms in the center of the booklet. "Hm. Does look simpler. I could save myself hours of grief this year." He closed it in self-satisfaction. "I'll take that deal any day. So, who's stupid now?"

Mary turned back to the kitchen, so he wouldn't guess her answer.

* * *

The Chief of Staff placed a binder on the desk. "The preliminary report on tax status appeals, Mister President." The President picked it up and read, his face remaining impassive. "Bad news, as if the media hadn't told us already. Phone lines are jammed, offices are swamped. The *Post* is reporting the IRS has given up processing, that appeals automatically get the status rescinded. It's a disaster."

The President laid down the papers, and smiled. "No, it isn't, Tom."

"Sir?" The Chief of Staff goggled. "Mister President, with all respect, you expended every ounce of your political capital implementing this tax. Every group in America thinks you're discriminating against them personally. Worst of all, compliance numbers are plummeting. Apparently, even stupid people—no offense to them," he muttered, "—aren't stupid enough to let themselves get taxed."

"Good. I never intended them to." He watched his aide reel, and finally showed some mercy. "I was never targeting unintelligent people. Apathetic people, on the other hand—"

The Chief of Staff looked like a deer in headlights. "Bu—th—what about the cutting-edge computer program?"

"Picks people randomly." The President turned to watch the budding trees outside the Oval Office windows. "Stupidity isn't the worst drag on democracy. Indifference is. If people who can't be bothered to rouse themselves in their own defense take a hit in the wallet, that's the least they deserve. If the rest get galvanized out of their less pervasive complacencies, well, it's worth it to bear a little of their wrath. But that doesn't leave this room, understand? Not until April sixteenth, anyway."

"Uh, yeah. I'm going to head home a little early today, Mister President."

"Trouble with the family, Tom?"

"No, just . . . paperwork."■

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Christopher L. Bennett

AGGRAVATED VEHICULAR GENOCIDE

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Big capabilities, unfortunately,
include the potential for big mistakes. . . .

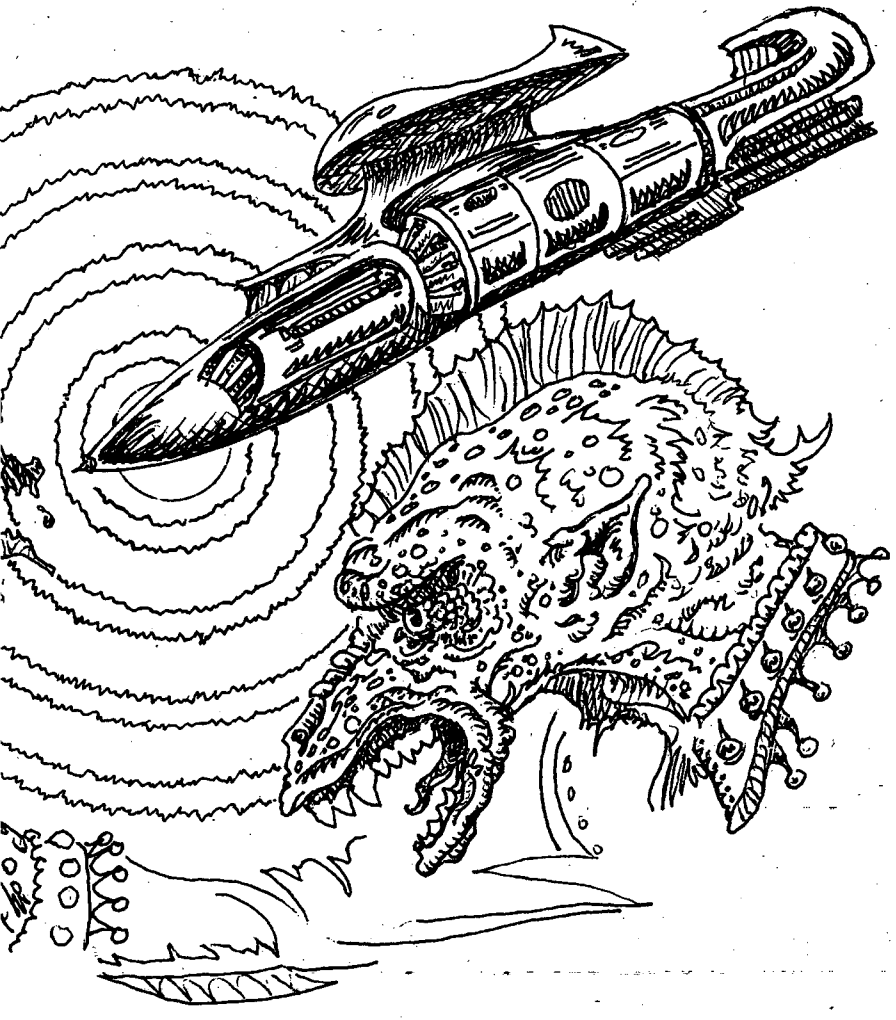

Illustration by Kelly Freas

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Arachne was a spiderweb spinning in space. Her strands were fullerene wire, cylindrical molecules of pure carbon a trillion trillion atoms long. The spin of the highly conductive web spawned a magnetic field megameters wide, which sucked in the hydrogen ions produced when *Arachne*'s vast lasers illuminated the cosmic gas before her in her path. Concentrated by the trillions in the silvery engine core at the center of the web, the hydrogen atoms fused and powered the vessel on her long, lonely flight through interstellar depths.

An hour ago, *Arachne* had been coasting at ninety-nine percent of lightspeed, her ramfield and lasers at low power, deflecting gas and debris away from herself rather than pulling it into her belly. Her crew had slept soundly in her cryogenic embrace, and she had maintained her vigil over them, looking in to ensure their lifesigns remained stable, looking out to ensure their path remained clear.

But then something had dragged *Arachne* to a dead stop.

Stephen Jacobs-Wong briefed the crew as best he could in the minutes remaining before the aliens docked. Cecilia LoCarno captained the ship, but Stephen led the colonists, so they looked to him as they sought to understand what had brought about their premature awakening one-point-six parsecs and two time-dilated years short of their intended destination of Gamma Leporis V.

"Arachne woke the captain when she first noticed us slowing—and then noticed the alien ships," Stephen told them. "According to Captain LoCarno, we went from point-nine-nine *c* to practically zero in a matter of minutes." He strove to remain calm as he relayed this, to project that calm to the crew. Brown-skinned and Asian-featured, Stephen had the handsome charisma that made people naturally want to follow him. But the thing about waking up from four years in cryosleep was that you looked and felt like you'd been asleep for exactly that long. The crew looked up at him blearily, like a mass advertisement for intravenous coffee. Stephen felt much as they did, but he strove to keep his gaze clear and reassuring. His outright shock at what had happened did a lot to keep him awake.

"From the Doppler shifts she observed in the starlight," he went on, "Arachne thinks the aliens hit us with some kind of gravity beam. Like a huge tractor beam."

Chaim Silbermann, the chief engineer, shook his head in awe. "The power expenditure must be incredible. Whoever they are, they *really* wanted us to stop."

One of the exobiologists—a small, delicate woman named Zena Bhatiani—asked a question that hadn't occurred to him. "Will we be able to talk to them?"

Arachne herself answered that one. "The alien computers established an interface with me several minutes ago," the ship reported over the intercom. "A translation program was initiated, but then terminated. This suggests that the computer recognized our language as one already in its database."

"Not too surprising," mused Silbermann. He was a stocky, bearded man in his robust seventies, just past middle age. "We've been broadcasting into space for centuries."

"Arachne, did you learn anything about them while you were interfaced?" Stephen asked.

"Only about their cybernetic designs and protocols. Nothing about the aliens themselves. They seemed reluctant to provide information."

"That's not good," opined one of the crew—an opinion others echoed.

"We shouldn't jump to any conclusions," Stephen cautioned. "We don't know anything about them yet."

"We will soon," Arachne interjected. "They're sixty-eight seconds from docking."

"Zena, Chaim, I think you should come with me," Stephen said with the tone of a suggestion and the authority of

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a command. "The rest of you should stay here. Arachne will keep you posted."

"But what if they're hostile?" someone asked. "I mean, they dragged us to a dead stop without permission, without a word. That's hardly a friendly act. So shouldn't there be more of us there, just in case?"

"Look at us," Stephen countered with a sardonic grin. "We're just out of cryosleep, we can barely stand up. If they're hostile, the best thing we can do is try not to antagonize them."

"Forty seconds," Arachne prodded.

Stephen nodded at Bhatiani and Silbermann. "Come on."

Arachne had no docking port *per se*, since an interstellar vessel headed for an uninhabited system wouldn't be expected to take on passengers. But there was a maintenance airlock on the rotating habitat ring. The alien ship—which Arachne indicated was only one of numerous such vessels surrounding her—attached a docking port of its own to the lock, after using some sort of gravity drive to match *Arachne*'s rotation. The light emanating from the rear of the ships was not rocket exhaust, but seemed instead to be high-energy particle emissions from annihilation reactors.

Arachne's supplies did include stunguns for dealing with any hostile Leporian wildlife the colonists might encounter; but those guns were all in the landing craft which hugged the engine core of the ramship, hundreds of meters in from the habitat ring. So Cecilia LoCarno and the others had to meet their gate-crashers unarmed, and pray that they intended no harm.

The airlock opened and the first alien entered the ship, its long body barely able to fit in the lock. It was a tailed biped with an almost kangaroo-like build; but its arms were nearly as long and powerful-looking as its legs, with two fingers and two thumbs on each hand. Through its helmet, Stephen could see a long-snouted, blue-skinned head with a crest of bristly hair—or possibly some sort of sensory cilia—running from the "nose" to between its bulbous, chameleon-like eyes, which were sheltered under large bony crests.

As a second alien began cycling through the lock, LoCarno steeled herself and strode up to face the lead alien. "I am Captain Cecilia LoCarno of the Human ramship *Arachne*, from the planet Earth. Identify yourselves, and explain your reasons for interrupting our voyage." Lanky yet strong-looking, her severely cut hair gold-tinged with steel, the captain radiated a confident authority which Stephen envied. But he'd seen the look in her eyes when she'd told him about the aliens and their gravity beams. Cecilia was as frightened as he was.

The alien remained silent for a moment, probably listening to a computer translation. Then it opened its mouth, revealing omnivore's teeth, and began to speak. The translation emanated from its pressure suit's speaker. "I am Rillial. We are the Chirrn. We are the survivors of the vessel Lesshchi. Explain *your* reasons for destroying the vessel Lesshchi."

Four pairs of human eyes widened in shock; the aliens, now four in number themselves, watched the unfamiliar anatomy curiously. "*What?*" Cecilia finally asked.

"Explain your reasons for destroying the vessel Lesshchi. Is there a translation problem?"

"No, it's . . . There must be some mistake. We haven't destroyed any ships. We're colonists, not fighters. Besides, we've all been in cryogenic sleep until you captured our ship. The only person who could've done anything is the ship herself. And Arachne would have no reason to destroy an alien ship." *Unless she knew that ship posed some threat,* she thought. But Arachne had mentioned no such action.

"The Chirrn vessel Lesshchi," Rillial countered, "was destroyed by several high-powered beams of collimated light tuned to the ionization frequency of hy-

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drogen gas. Do you deny that your ionizing beams are capable of pinpoint focus?"

"No," interjected Silbermann. "Um, I'm Chaim Silbermann, the chief engineer. The, uh, the lasers can be focussed. If the defense systems detect an asteroid or comet in our path, the lasers can focus to vaporize it before it hits."

"Chaim!" LoCarno hissed, glaring at him.

Silbermann shrugged, then turned back to the Chirrn. "But . . . but we couldn't have destroyed your ship. The system checks for engine emissions and such before it locks on to fire. If your ship had been in our path, Arachne wouldn't have shot it. She would've vectored our thrust, tried to veer off."

Arachne spoke up. "Captain, I did fire on an obstacle shortly before the Chirrn captured us. But there were no emissions indicative of propulsive engines, and no indication of a lightsail. And I estimate the size of the object at twenty to thirty kilometers, which is far too large for a spacecraft."

Rillial's eyes swiveled to focus on LoCarno once more, but not before taking in all four humans. "The vessel Lesshchi did not have propulsive mechanisms as you would understand them. It was maneuvered gravitationally."

"But your ships have particle exhausts," Arachne observed. "No such exhaust was noted from the obstacle—which was far larger than your ships in any case."

"The vessel Lesshchi was not a transport vehicle. It was our home. The Chirrn do not dwell on planets, as you do. We dwell in vessels which travel between the stars. Vessels which house thousands of Chirrn."

"Oh, Great Mother," Stephen breathed. "There *is* a translation problem. 'Vessel' doesn't just mean 'ship,' it means 'container.' Like something which contains an artifical environment. Cecilia, they're saying the *Lesshchi* was a space habitat!"

"Correct," Rillial said. "Lesshchi was habitat to over eight thousand seven hundred Chirrn. We survivors number less than three hundred fifty. All the rest—nearly eight thousand four hundred of my people—are dead."

"Eight . . . thousand people?" Stephen gasped. "And we . . . we killed them?" The shock overcame him in his weakened state. His legs folded beneath him, but Chaim Silbermann caught him and held him upright. Yet the engineer looked none too steady himself.

The captain showed no reaction, silently meeting the alien's accusing gaze. Finally she spoke. "I'll believe it when I see proof," she said coldly.

"Cecilia!" Stephen cried, stunned.

"And you shall see it," Rillial told her. "Your vessel will be towed to the site."

The captain nodded, then turned to meet Stephen's disbelieving gaze. In humanity's technically advanced society, where almost any physical evidence could be falsified, where only an expert forger or simulation artist could recognize a forgery or a simulation, the word of honor had become a precious commodity. Breaking one's word was a taboo on a par with rape, and questioning another's word was a heinous accusation. It was the only way society could survive when illusion became indistinguishable from truth.

"I know, I know," Cecilia whispered, as aware of this as Stephen was. "But they're aliens. Who knows how they think?"

Stephen expected that beings so much more technically advanced would have an even greater need for honor. And if Cecilia couldn't trust them, how could she trust their evidence? It didn't seem to make sense.

Then again, Stephen realized, he couldn't blame her for not wanting to believe the Chirrn's accusation. He didn't want it to be true either.

Words of honor aside, perfect forgeries aside, there was still nothing quite so potent as seeing a thing before your eyes. And Stephen could only wish he didn't have to behold this sight.

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The Chirrn habitat had been a vast, rotating cylinder constructed from an asteroid, apparently using the same basic techniques that human spacers had used for over a century. Now it tumbled and drifted erratically through space, the sheer size of the habitat making its wild motions seem slow, almost stately.

One end of the iron-nickel cylinder had been blown completely open, the ragged, melted edges a testament to the sheer heat and power of *Arachne*'s lasers. When the opening tumbled into view, Stephen could see the charred, lifeless remains of forests and fields; Chirrn-made lakes and riverbeds robbed of most of their water, with what remained glistening as ice; Chirrn cities burned, wrecked and devoid of light or movement. One city had been ripped clear through, its twisted, melted towers jutting from the open end of the mangled cylinder.

Stretching back behind the habitat was a long, expanding trail of debris, bits and pieces of an advanced civilization torn apart into meaninglessness. Stephen tried not to look too closely at the debris. He knew some of it was organic. Some of it was Chirrn. Some of it was children.

Rillial stood behind the captain and Stephen at the viewport, and spoke in a tone whose coldness was clear even through the barriers of mechanical translation and alien inflection. "Your beams hit near the southern end of Lesshchi and melted through in milliseconds. The air inside was superheated instantly, cooking us by the thousands. The pressure hastened the rupturing of the hull, and the outracing air blew the southern end completely away."

Arachne spoke, her synthesized tones lacking inflection. Perhaps she was too shocked to simulate human speech mannerisms. "I fired at one end of the perceived asteroid," she explained, "in the hopes that the catastrophic vaporization would provide enough pressure to propel the remainder out of our path." There followed what for a cyber was a lengthy pause. "Now that I think about it, the asteroid's subsequent acceleration suggested a much smaller mass than I'd assumed from its size. As though it were hollow."

After a pause (for no one knew how to respond to that), Rillial continued its tale. "Only those of us who were inside the infrastructure at the northern end were spared from the heat and the vacuum; but many of us were killed by the turbulence of the explosions and hull ruptures. Most of us who survived were already in our ships at the time; very few others were able to reach ships before death reached them." Rillial turned to spear the captain with its gaze. "A death for which you will be held responsible."

Cecilia glared at the alien angrily, but maintained her calm. "I agree this was a great tragedy . . . Rillial." She still didn't know whether the alien was a *Mr.* or a *Ms.* "But we did not do this knowingly. It was an accident."

"In space, accidents are usually fatal. To fail to guard against accident is intolerable negligence. Only a planet-dweller would claim accident as an excuse." Though it was hard to read the alien's emotions, Rillial seemed to say "planet-dweller" with considerable contempt.

But as Stephen stared out at the wreck of Lesshchi, he couldn't help but feel that contempt was justified. "Rillial . . . " he began hesitantly, "is there anything we can do to help you? To try to make up for what we've—"

"Stephen!" LoCarno warned sharply. She pulled him aside and spoke quietly, hoping the Chirrn translators wouldn't pick up their voices. "Don't say anything that would imply culpability on our part."

"But—"

"I'll make it an order if I have to. We have to think clearly. It's a horrible thing, yes, but we don't know what they plan to do to us. We don't want to say or do anything that would make it easier for them." She quailed at the expression in Stephen's eyes. "Don't look at me that way. I feel for them too. But my duty is to the passengers and crew of

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this ship, and to the hundreds of frozen embryos we're carrying. I have to place their interests first.

"What you were about to say could've been taken as a confession. And there's no telling what consequences that would have in their legal system. If they even plan to use their legal system, instead of just taking revenge. *We don't know* what they'll do. So we have to be on our guard, no matter what we may feel for their dead."

Stephen sighed heavily, but nodded. He'd been weakened by the cryosleep and the shock he'd faced upon awakening, but he was a leader, a pioneer, and he could accept cold realities. "Okay. So we need to find out what they plan to do next."

The next step, according to Rillial, would be a trial to determine the humans' culpability in the destruction of Lesshchi. The refugees proceeded to tow *Arachne* and her crew to the nearest intact Chirrn habitat. This took surprisingly little time—less than a day, in fact. Perhaps the Chirrn habitats travelled in packs; perhaps their ships gravitically accelerated *Arachne* to within a very small fraction of lightspeed, time-dilating them by a factor of thousands; perhaps, for all *Arachne*'s crew knew, the Chirrn had hyperlight drive. Not only would the Chirrn tell them nothing, but they confined the crew in windowless rooms and blinded *Arachne*'s sensors.

Before towing *Arachne*, they had made her reel in the fullerene web and halt her rotation, leaving the crew in freefall. This gave the Chirrn guards a significant advantage, for their forms seemed finely adapted to life without weight. In microgravity they were sinuous and graceful—long, almost serpentine bodies sliding through the air, grasping handholds with fingers and toes, using their powerful tails and flexible spines to maneuver like cats twisting in midair. Now that contamination tests had proven it safe, the Chirrn had discarded their pressure suits, under which they wore only utilitarian vests; they had no sign of genitals in the usual place, so their sexes remained unknown. Behind their eye ridges, their bristly snout-hairs gave way to long, horselike manes which trailed elegantly behind them as they maneuvered in microgravity. Their skin colors were predominantly blues, often shading into violet or green. The manes seemed to come in all colors of the spectrum. Whether this was natural or cosmetic was unknown, for the Chirrn seemed unwilling to reveal anything about themselves to the humans they guarded.

Perhaps this was more than just secretiveness. The Chirrn made no secret of the fact that they blamed the humans for the deaths of their loved ones, the destruction of their homeland. It took barely an hour before a group of Chirrn guards snapped and attempted to beat their prisoners to death. Fortunately, most of *Arachne*'s crew had been raised in Earth's high gravity and were able to defend themselves against the lighter Chirrn until Rillial arrived to impose order. Still, three of the crew—including tiny Zena Bhatiani— had needed serious medical treatment. And though Rillial reassigned the guards, the alien leader offered no apologies. "For myself," Rillial told them, "I would have happily joined them in killing you all. But there must be law. The tribunal will judge you."

As soon as the humans were brought into the Chirrn habitat named Shilirrlal, they were subjected to thorough medical examinations followed by a lengthy and unpleasant decontamination process—stripped naked, then collectively herded through a series of chemical immersion baths, uncomfortably hot "room-temperature" plasma bursts, nanotech "cleansings" of their respiratory and digestive tracts, and unknown other processes before finally being handed simple, ill-fitting garments which the Chirrn had synthesized for them. It was

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unclear why this was necessary, since the aliens' own tests had shown Terran and Chirrn biochemistry to be too different for infection to occur.

Then the prisoners were brought out into the open. Hundreds of Chirrn were watching, fascinated by the sight of the humans, but remaining at a distance as though they were somehow unclean. Stephen looked up to see a live image of himself and his crewmates on a large holoscreen in a nearby plaza. He realized that their decontamination must have been broadcast to the public. The entire procedure had been symbolic, to reassure the citizens of Shilirrlal that they would not be contaminated by the impure aliens. Stephen blushed fiercely. He wasn't modest about being seen nude, certainly not by aliens; but the knowledge that so many had watched the humiliating procedure made him ashamed, on behalf of the entire crew. He looked at Cecilia, and saw her realizing the same things he had; but her expression was bitter cold.

Shilirrlal looked as Lesshchi must have before it was destroyed. Presumably it was a typical asteroid-built cylinder on the outside; but inside, it was uniquely Chirrn. Everywhere towers and terraces soared above the humans' heads, along with lattices stretching toward the central axis, climbed by vegetation and by Chirrn. It was an odd visual paradox; the architecture seemed to be striving for the sky, yet at the same time enclosed and introverted, for the sky was in the center of this wraparound world.

True to their kangaroid build, the Chirrn moved by hopping, keeping their bodies and tails horizontal as they leapt forward, assuming a vertical posture only at rest. They built large, to accomodate their long bodies and bounding locomotion. Stairways had only two or three steps between one story and the next; sometimes Chirrn would bound directly to a higher level, pulling themselves up with their arms like a cat leaping onto a high perch. Sometimes they climbed ladders and lattices with a brachiator's agility, grasping with fingers and toes.

A few hundred meters above ground level was a large, open framework forming an inner cylinder, the conduits over a meter thick and dozens of meters apart. Inside it, Chirrn soared in free fall from one tower, one terrace, one handhold to the next. Up ahead, Stephen saw a large globe of water jiggling through the air with small Chirrn swimming gaily through it. "Could that framework be generating some kind of antigravity field?" he asked Chaim Silbermann, speaking quietly so as not to antagonize the guards.

"Well, there's no real gravity to begin with, just rotation. In the air, it's the Coriolis winds that shove you sideways and out, toward the ground." The bearded engineer peered at one of the conduits as they passed underneath it. "I'd guess the framework's somehow isolating the air in there, keeping it still. Maybe their gravity technology; maybe just magnetic or optical particle manipulation. Who knows?"

"Well, whatever the reason, it's beautiful," Stephen said as he observed four brightly colored Chirrn flying intricate patterns around each other in what could be a sport, a piece of performance art, a mating dance or all of those. "This is what we destroyed, Chaim," he breathed, and his view of the aerial dance was blurred by tears.

There was a long pause. "I know," Silbermann finally said, almost too softly to hear.

Though Shilirrlal's rotation produced less than sixty percent of an Earth *g*, not all of the humans were able to traverse the Chirrn's high steps and climbing-lattices. The forty prisoners were taken up into the towering justice center by a cargo lift.

During their processing (Stephen wondered if "booking" was a fair analogy), they were provided with earplug translators. The devices were receive-

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only; presumably the Chirrn had their own earplug or implant translators already. "That's odd," Cecilia observed after they'd been confined. "They seem so isolationist, so disdainful of other races: You wouldn't expect them to use translators on a regular basis."

"I don't think it's all races they dislike," Zena Bhatiani told her. "They seem to have a specific bias against planet-dwellers. When the guards . . . attacked us . . ." Zena shuddered, understandably. Even after a day in a medbed, she still bore bruises and scars. "The things they said, the insults . . . 'Ground-vermin.' 'Dirt-grubber.' 'Well-digger.'"

"'Well-digger?'" Cecilia asked.

"I guess like a gravity well. A planet." She tilted her head. "And maybe also because digging a well is something you can only do on a planet. Anyway, their use of translators suggests they do interact with other races. They just don't like ones that live on planets."

"That must narrow their list of friends a great deal," the captain said.

"I don't know. The number of humans who now live in space habitats instead of planets is close to a billion. And we haven't met all that many aliens yet."

The discussion was interrupted by the opening of the cell door. An atypically stocky Chirrn, turquoise-skinned with a yellow-white mane, trotted into the large, austere chamber and surveyed the prisoners. "Are there any among you who are not of planetary birth?" was the being's first question.

Cecilia stepped forward. "Why do you want to know?" she asked.

"Are you of non-planetary origin?"

"No. I was born in Venezia on the planet Earth and proud of it. I also happen to be the captain of this group, so I'm the one you speak to. Now, just what have you got against planet- dwellers?"

The Chirrn looked around at the crew, ignoring her. "I am L'chellin. I have been assigned as your advocate for the tribunal. I advise you that it would be in your best interests to choose one not of planetary birth to speak for your crew. I repeat my query."

Cecilia moved before L'chellin, meeting its chameleon gaze firmly. "And *I* repeat, I'm the captain," she said sternly. "I speak for this crew, and you're going to have to accept it. Now, I asked you a question."

The alien made a sighing sound, its snout-bristles ruffling. "Very well. But you will have to live with the consequences of that choice."

"I'm waiting for an answer," Cecilia went on implacably. "We have a right to know—are we going to be tried fairly, or persecuted due to our origins? We need to know just how deep this anti-planet bias of yours runs."

L'chellin rotated its eyes back into its head, like a human pressing one's eyes shut in weariness. "We believe ourselves to be a rational people," it said. "Our civilization has thrived for over ten thousand years." Later, Silbermann would point out that the translator was handily converting base-eight numbers into their base-ten equivalents—another indication that the Chirrn routinely interacted with other species, species with different numbers of fingers. "But our . . . discomfort with planet-dwellers is deeply rooted in our history.

"Our primitive ancestors evolved on the planet Shayal. When the ability to enter space was devised, many of our ancestors left Shayal and became the first Chirrn, building their own worlds which proliferated throughout the system of the star Roj.

"But those who refused to leave Shayal failed to learn the responsibility for their ecosystem that space-dwellers must learn quickly. In their sloppiness they fouled Shayal, and came to depend on the Chirrn for support. Sadly, the Chirrn were subject to their rule, and were forced to submit to ever-greater demands." The advocate's recitation had the tone of a story learned in childhood and swallowed whole. "Finally the Chirrn rebelled against the tyranny of

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the Shayaln. The wars lasted for many decades, bringing great death.

"Naturally, the Chirrn had the advantage. Their resources were greater, not limited to what a single planet could offer. They could block the Shayaln's sunlight, reducing their energy supplies. And the Shayaln were at the bottom of a gravity well, where they could be easily bombarded. But the Chirrn held back, out of compassion for their planet-dwelling cousins.

"But the Shayaln's isolated, poor existence had twisted their morals. They showed none of the restraint of the Chirrn, attacking ruthlessly at every chance. Peace talks were used as opportunities for ambush. Medical ships were destroyed, biological weapons were used, against all laws and treaties." L'chellin lowered its head. "Finally we reached the point where we could not tolerate coexistence with the Shayaln. Many argued that we should crush them utterly. It would have been easy to bombard the planet with asteroids until it was barren of life. But we had more decency than that. Instead, we chose to leave the Roj system forever, and live among the stars.

"It proved the best decision we ever made. It liberated us. We were no longer restricted to the orbit of a single star. We could discover the universe without leaving our homes."

L'chellin looked back at the captain again. "So you can understand that to live on a planet, to trap yourself within a gravity well and spend your entire existence in one place, is inconceivable to us. It would be the worst form of imprisonment. And, given what the Shayaln did to our ancestors, we feel it must twist beings' minds and morals beyond the point where they can be civilized. To us, planet-dwellers are dangerous savages who must be avoided at all costs." L'chellin tapped its hands against its brow ridges, as though symbolically hiding its eyes; this seemed to be a gesture of unhappiness. "And what you have done to Lesshchi only reinforces this belief."

"Now wait a minute, mister or Ms. or whatever you are—"

"I am currently male."

Cecilia decided not to touch that one. "I thought you were supposed to be defending us in this trial."

"Do you deny that your collimated-light projectors destroyed Lesshchi?"

"No. But it was an accident. We didn't even know what Lesshchi was until its survivors dragged us out of relativistic. We're sorry for what happened. Deeply sorry. We try to be a peaceful people, to respect all life. But accidents happen.

"So the question, Mr. L'chellin, is: do you accept that it was an accident, and are you capable of doing your best to persuade this tribunal of that fact despite their anti-planetary biases? Or is your role just a formality in a—a show trial whose outcome is already decided?" For a number of reasons, she had chosen to avoid the phrase "kangaroo court."

The Chirrn's eyes swivelled to focus on hers. "I take my duties seriously. No space-dweller who executes one's duties sloppily can expect to survive for long. My role is to participate in the search for the truth and the determination of justice. I will not allow myself bias in that pursuit."

Cecilia stared searchingly into those alien eyes, seeing nothing she could recognize . . . save for his unwavering gaze. "All right," she finally said. "That sounds pretty much like the role of the attorney in our legal system, so I can accept it. Now how much time to we have to work out a defense strategy. . . ?"

Another translation glitch: in the Chirrn legal system, the role of the "advocate" was not to speak for the accused, but merely to advise the accused in legal principles and procedures; the defendants were expected to speak on their own behalf. This, L'chellin explained, was why he had advised them to choose

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a non-planetary native as their spokesperson; such an individual would be seen more sympathetically by the tribunal.

The tribunal panel consisted of six Chirrn who sat behind a long, raised construct not unlike a judge's bench. The tribunes were elected by the people, but would serve the approximate role of a jury. Before them in the center was the arbiter, who would ensure that proper procedures were followed; this individual filled some of the functions of both judge and bailiff. Along the sides of the courtroom were witnesses' benches, and the rear contained limited audience seating.

It seemed to Stephen like a reasonable setup. He wondered if the Chirrn, like some human cultures, had gone through a period in their past when the courtroom had become an arena for combat between self-serving lawyers rather than a place to seek the truth. Perhaps the prominent position of the tribunes and the relatively subordinate role of the advocates was a reminder that the lawyers were there to serve the clients and the jury, not the other way around.

Perhaps in keeping with the diminished role of the attorney/advocates, there were no opening statements. The tribunal began with the arbiter briefly spelling out the basics of the case: the involved parties, the charges, and so on. It then proceeded directly to what was called the stating of grievances.

Rillial, as a representative for the aggrieved parties, spoke for the prosecution. The cobalt-skinned, mahogany-haired Chirrn (who, according to L'chellin, was "currently female") spent considerable time describing the exact details of the destruction of Lesshchi, including a listing of all the familial or clan groupings which had lost members or been exterminated in the event. LoCarno objected to this as prejudicial, to which the arbiter countered that it was necessary and proper to identify the aggrieved parties in a legal proceeding, normally by name and family, but in this case only by family due to the sheer number of victims.

Cecilia offered no more objections and asked no questions—partly as a way of pointing out that she and her entire crew had been unconscious during the incident and thus had no perspective of their own to counter with. As Rillial continued her litany, her intense emotion barely hidden under her courtroom formality, Cecilia sat quietly, seeking to project an air of sorrow without guilt. Few others of the crew were able to maintain such reserve as Rillial spoke of the horrors which their ship's defenses had wrought. The Chirrn audience and witnesses were even more severely agitated—some seeming ready to attack the humans. So after Rillial's presentation, court was adjourned for several hours to give them time to calm down. (Apparently the Chirrn had no regular day/night cycle, since that was a planetary sort of thing; Chirrn slept when they had nothing else to do.)

When the tribunal reconvened, it was the defendants' turn to explain the circumstances under which they had become involved in the incident. This part was handled by Stephen. "My name is Stephen Jacobs-Wong," he told the tribunal. "Twenty-six objective-time years ago, in the Earth year 2150, I organized an expedition to colonize the planet Gamma Leporis Five, which orbits the larger, yellow component of a binary star system twenty-nine light-years from Earth. An automated probe to that system had shown that planet to possess the right conditions to support terrestrial life forms, and had shown no sign of intelligent habitation of its land masses.

"Twenty-four objective-time years ago, we set out for Gamma Leporis in the hydrogen-ramjet vessel *Arachne*, commanded by Cecilia LoCarno. In addition to forty live humans and our colonization supplies, *Arachne* carries frozen embryos and genetic matrices of many terrestrial organisms, including six hundred frozen human embryos, which

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we would gestate upon settlement, using both artificial equipment and the wombs of our female members."

"You forty," one of the tribunes asked, "would raise six hundred young?"

"Well, not all at once. The embryos would be used gradually to boost our numbers and help us build a stable, diverse population base. We anticipate it taking two or three generations before all six hundred are born.

"Anyway, in order to minimize power and resource expenditure on our voyage, it was decided that all the settlers would make the journey in cryogenic suspension, and that *Arachne* would be provided with a fully sentient brain which would run the ship. The captain and necessary crew could be awakened if a crisis arose."

Ship's logs were produced as evidence that the entire crew had been frozen stiff at the time of Lesshchi's destruction. This was supported with the results of the Chirrn's own medical tests of the forty humans, which did show signs of recent awakening from cryosleep. Rillial countered that the accuracy of such tests was limited, especially with regard to a species never before encountered in the flesh, and that the same results could prevail if some or all of the crew had been awake before the "attack" on Lesshchi.

"I object!" Cecilia shouted. "There are no grounds for characterizing this incident as an attack, or an act of deliberate malice. The evidence clearly indicates that these events were not premeditated, and there is absolutely no basis for any contrary opinion.

"After all—you Chirrn don't exactly go out of your way to make contact with planet-dwelling races. We had no idea you even existed before these events. So how could we possibly bear you any malice, or wish to attack you?"

"Because you're dirtballers!" came a cry from one of the Lesshchi survivors. Rillial and the arbiter urged quiet, but this merely triggered more shouting from the embittered Chirrn. The arbiter ordered another recess to allow calm to return.

Upon reassembly, the head tribune—a garnet-hued male with a sherbet-orange mane—spoke. "This panel concedes that there are no legitimate grounds for the assumption of deliberate malice on the part of the crew of the starship *Arachne*. All defendants, regardless of the circumstances of their origin, are subject to protection from unfounded charges. This issue will not be raised again.

"However," the tribune continued, "there remains the charge of culpability due to negligence. This issue will now be debated."

"Pardon me, Honored Tribunes." It was L'chellin, who stepped forward diffidently. There was some muttering from the audience; apparently it was unusual for an advocate to speak to the tribunes directly. "I speak on behalf of a defendant who is unable to attend. The starship *Arachne* has asked me to file a motion that the charges against the humans be dismissed. Since *Arachne* herself was the only individual conscious at the time of Lesshchi's destruction, and since the defense systems which destroyed Lesshchi are part of *Arachne*'s own person, she contends that she is the only one who should be placed on trial for that destruction."

This motion piqued the tribunes' interest considerably, and they pulled together to debate the question. Cecilia turned to Stephen and spoke softly. "I wonder why I didn't think of that. Arachne may just get us off the hook with that one."

"At the cost of her own freedom," Stephen reminded her. "Who knows whether they respect cyber rights here? If she's found guilty, Arachne may be reprogrammed or even killed."

"I know," Cecilia told him, placing a hand on his shoulder. "What I mean is, I'm gratified by her courage, her willingness to sacrifice herself for us." She frowned. "Though if our ship's convicted of a crime, what does that do for our chances of reaching Gamma Lep?"

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Stephen threw her a disturbed look, but before he could say anything, the head tribune spoke again. "Though it is true that *Arachne* was the only conscious member of the expedition, it is also true that she is officially a member of that expedition's crew. Is that not correct?"

"Yes, it is," Cecilia confirmed.

"*Arachne*'s actions were thus committed in service to her human passengers. This makes her passengers liable for her actions. It is a basic principle of Chirrn law that superiors are culpable for the actions of their subordinates."

"Honored Tribunes," spoke up one of the Lesshchi survivors/prosecutors—a deep-blue, grey-maned individual named Churrlaya. "Our studies of human law, based on their ship's records and on the signals we have recorded from their system over the past two centuries, suggest numerous precedents for this view in their own legal traditions. There are instances of war criminals being held culpable for actions carried out by their subordinates."

"Noted," the head tribune said. "Therefore, by both Chirrn and human legal precedents, the ramship *Arachne*'s motion is denied. She acted on behalf of the humans who stand before this tribunal; therefore those humans are the ones on which the ultimate blame, if any, will fall."

"Thank you, Honored Tribunes," Rillial said, one eye flicking around to leer triumphantly at the humans. "Rest assured, we will demonstrate the humans' guilt in this disaster."

"On what grounds?" Cecilia protested, taking full advantage of the rather loose procedures of the court.

"The grounds of criminal negligence."

"Honored Tribunes, there is no negligence here," Cecilia urged. "Just the opposite. As I will now show."

"Proceed," waved the arbiter.

"Consider the probabilities here. Two space vessels, each travelling its own course through interstellar space, each completely unaware of the other, just happen to follow intersecting courses—and what's more, both arrive at the point of intersection simultaneously. Given the immensity of space, what are the odds of such a thing occurring?

"As a species with over ten thousand years of experience in interstellar travel, you must appreciate even better than we do how immensely improbable it is for two vessels to meet with each other except by conscious design and careful maneuvering. According to your own records, which our advocate is now providing . . ." and as she said this, L'chellin handed a data crystal to the arbiter, "only seven such incidents have ever occurred in Chirrn history, and in all of them the two unrelated ships only passed within communication or sensor range, not within collision range."

Cecilia next called Chaim Silbermann to explain the basics of *Arachne*'s laser defenses. "The beams are spread out into a conical shape by Fresnel lenses," the engineer explained, "in order to ionize the maximum amount of interstellar hydrogen. What happens is that the beam hits the focus node, a convex mirror at the focus of a parabolic dish. The mirror spreads the beam out across the dish, which then sends it out straight again, but wider than before. It then hits the divergent Fresnel lens and spreads out. But if the sensors detect an obstacle, the focus node can become transparent, letting the beam straight through, undiffused and very powerful. It can be directed by the node at any desired target. And, of course, there are six of them."

"Why do we need such a defense system?" Cecilia asked.

"Well, to destroy space debris in our path. Or to give it enough of a blast to push it out of the way."

"But what if it weren't space debris? What if it were, say, an alien ship?"

"Well, that's very unlikely."

"Yes, it is."

"Still," Silbermann went on, bringing a grin to Cecilia's face, "the designers did prepare for the possibility. We didn't

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want to cause any . . . well, anything like what happened.

"The defense computers are programmed to scan for signs that an obstacle is artificial—like the reflection spectrum of diamite or aerogel or other synthetic hull coatings. Or for engine emissions, the radiation or particles you'd see from a fusion or antimatter rocket. Let's see, it also looks for the EM signature of a ship propelled by a particle beam. And of course it could spot a lightsail easily, from its reflectivity."

"And what happens if the sensors show the obstacle is artificial?"

"Well, we don't blast it. Instead, maneuvering thrusters are fired to turn the ship."

"But if the ship is travelling at ninety-nine percent of lightspeed, you wouldn't have long to react before the obstacle reached you. If the object were a hundred light-seconds away, you'd only have a second to respond."

"Well, our sensors can see much farther than that. And the computers can compensate for the timelag, extrapolate the true position of the obstacle. They're very fast. And at that speed, even a small change in direction would add up damn fast. We might not be able to clear the obstacle entirely, though; it might still hit the magnetic web. But odds are it wouldn't hit a laser or do any irreparable damage. Even if it did, we could probably limp along to our destination with a damaged web."

"So protecting the other ship is a higher priority than avoiding damage to our own."

"Well, of course."

Cecilia smiled again. "Of course. Honored Tribunes, we've established that an accidental collision between interstellar vessels is an event of vanishingly low probability. Yet *nonetheless*, the designers of *Arachne* went out of their way to protect against a tragedy that would almost certainly never occur, even at the risk of damage to the ship herself. This, Honored Tribunes, is the precise opposite of negligence. If anything, it is caution above and beyond what any reasonable being would find adequate."

"Yet clearly it was not adequate," Churrlaya interrupted. "Your sensory parameters did not prevent your defense system from destroying Lesshchi."

"That's because Lesshchi maneuvered using gravity control. That is a technology we don't have, aren't even close to having. It's impossible to expect us to prepare for encountering a technology we didn't know existed."

"But what if you encountered a space-going habitat which were not using any of its engines, even of the kinds you do have? Your defenses would then destroy it."

"No they wouldn't," Silbermann interjected. "A habitat like that would give off infrared, emit visible light through its star windows, broadcast in radio. But yours did none of those things. In fact, L'chellin here tells me that the Chirrn try to avoid giving off any radiations that might get them detected by planet- dwelling races. Says you don't want 'em getting curious about you, coming to take a look."

Cecilia pounced on that. "That's right! How could we possibly be expected to detect your habitats when you go out of your way to keep people like us from detecting them? And doesn't that place the culpability squarely on *your* shoulders?"

That, Cecilia realized, may have been a mistake. The insinuation that the Chirrn had caused their own death sparked an uproar in the court. One of the Lesshchi refugees screamed in fury and leaped forward, clear over Rillial's body, lunging at the humans. Several other refugees and some of the audience began to follow. The humans huddled together defensively. But in moments the Chirrn agitators had all been stunned by the baton-like weapons of the guards, who had acted quickly, realizing how little it would take to start a riot. The arbiter ordered another recess of several hours, and the prisoners were quickly taken to the relative safety of their cell.

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The tribunal did not reconvene again for more than a day. When the next session finally began, the head tribune spoke. "The suggestion that our own secretiveness has contributed to this incident cannot be casually dismissed," he said gravely. The audience grumbled, but quieted under the glares of the arbiter and the guards. "We advise the Council to consider the installation of short-range beacons on Chirrn habitats."

"In that case, Honored Tribune," Cecilia spoke up, "I submit that the charge of negligence on our part has been disproven, and move that the case be dismissed."

"That would be premature," Rillial countered angrily. "The accused's contention that they have taken all reasonable steps to minimize risk is false. There is one fundamental risk they have taken that did not need to be taken at all. And that is their very means of transportation."

"You'll have to explain that," Cecilia said coldly.

"I shall," came the terse response. "A ramjet-driven spacecraft is an intrinsically hazardous form of transport. In order to gather the fuel necessary to accelerate to near-light speeds, it must use collimated-light projectors to ionize huge volumes of hydrogen gas so that it may be drawn into the ship by its magnetic field. A ramjet affects a volume of space much greater than the size of the vessel itself, exposing that volume to powerful optical and magnetic effects which could be disruptive at the very least to any nearby vessels.

"Additionally, the sheer velocity is a risk factor. At velocities so nearly approaching lightspeed, the craft's sensory beams barely precede the craft itself. Once an obstacle is detected, even the fastest computer barely has time to decide upon a course of action. Once one factors in the time for the sensory beam to travel out and return, the time for processing within the computer, the time for signals to travel along the web to the collimated-light projectors, the time for the focus node to change from reflective to transparent and to direct the beam to the desired target, and so on, there can be very little time remaining for the actual process of judgment in which the computer decides whether or not an object is inhabited. The risk is needlessly great."

"The risk is to our own ship at least as much as to anyone else's," Silbermann objected. "So we wouldn't take it if we didn't think it was reasonable. We took all those factors into account in our simulations, and there was still plenty of time left to make good judgments. *Arachne*'s neural net is superconductive; her thought impulses travel even closer to lightspeed than she herself can. Plus, this technology's been tested and proven on more ships than just this one. It is safe, as safe as it needs to be."

Rillial whirled to face the tribunes, her tail almost knocking down Churrlaya. "*That* is the key question! *Need.* We must ask, did these humans *need* to travel this way at all?

"In fact, it is surprising that we encountered a ramjet-using race where we did. The region of space we currently occupy was swept clean of most of its gas and dust by a supernova explosion in the distant past. In fact, it is the innermost of a cluster of four such supernova bubbles, for which this region of the galaxy is well-known. Here, within this bubble, the gas density is roughly one-twentieth of the galactic norm."

"We're aware of that," Cecilia responded. "We call this bubble the Geminga Shell, after the pulsar known to be the remnant of the supernova which created it."

"So you are also aware that ramjets are far more inefficient here than they would be elsewhere in the galaxy. They must employ much larger collection fields, much more potent collimated-light projectors, to gather sufficient fuel." Rillial turned back to the tribunes. "Most species within the 'Geminga

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Shell' and the three bubbles surrounding it do not use ramjets. Generally, they do not engage in interstellar travel until they develop gravity control. Those that do usually employ lightsail or particle-beam propulsion, or vessels which travel at low fractions of lightspeed; or they employ the Chirrn method of creating their own worlds which spend generations travelling between the stars.

"Given the inefficiency of ramjets in this region, an inefficiency great enough to preclude most local species from using them at all . . . and an inefficiency of which the humans, by their own admission, are aware . . . we must ask why they have found it necessary to use them."

"The problems aren't insurmountable," Silbermann countered. "You just need a bigger collector web, more potent lasers. Sure, it uses more resources to build them that way, but we've got resources to spare in Solsys."

"But why use them at all, when there are easier, if slower, ways to travel between stars?"

Stephen stepped forward. "While it's true that the resources of Sol System have made humanity wealthy, the planet Earth is still severely overcrowded. Not only does that put great strain on an ecosystem we're trying to restore to health, but it greatly increases the threat of plagues. Earth spends as much effort fighting the new virulent diseases that keep cropping up as it does restoring the environment.

"So the people of Earth consider it their highest priority to reduce the planet's population. Of course, we encourage emigration to the other settled planets and artificial habitats of Solsys . . . but we recognize that even Solsys has its limits. And many of us do yearn to live on a planet without needing to huddle under domes and stare out at a barren wasteland. So part of the population-reduction program is an active search for habitable worlds in other star systems which we can colonize.

"Now, once a colony's established, we'll want to allow more humans to migrate there, if it's close enough to be practical. We want to be able to send the ship back for more colonists. And we want that process to happen as quickly as it can, so we use ramjets. They're the only thing practically able to travel at relativistic speeds."

Rillial pondered this for a moment before speaking. "So . . . you live on one planet and want to live on another. You want to find a naturally habitable planet, and must look to other systems to find one. And you are thus willing to go to extraordinary lengths, to engage in construction projects of truly immense scale and expend astronomical amounts of power, in order to fulfill this urge.

"But why?" she continued, turning and raising her voice to address the tribunal at large. "You have over a century of experience in space colonization. Over a billion humans live in artificial habitats, most of which are not located on planetary bodies. This mode of existence has proven viable for humans for over a century. Indeed, the enormous undertaking of constructing non-gravitic interstellar vessels would be impossible if you were limited to the resources of one planet. If space colonization had not proven successful, indeed highly prosperous, you could never have built a ramjet.

"So you know that human beings can lead successful, prosperous lives in space habitats. You know that generations of humans have lived, and lived well, without ever setting foot on a planet. And yet your desire to live on a planet like your Earth is so great . . . that you found it necessary to employ a highly inefficient, costly and outright dangerous form of propulsion in order to accomplish it. A form of propulsion which killed nearly eight thousand four hundred Chirrn."

Rillial strode forward to look Stephen firmly in the eyes, her wide-set orbs swivelling inward to fix him from two directions, making him feel cornered, pinned down. "Why did those Chirrn

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die? Because you used a ramjet. Why did you use a ramjet? Because you wished to live on a planet.

"But did you *need* to live on a planet?" she hissed with anguish. "Tell me that, colony leader. Given all the alternatives, was there some vital need for you to ram your way recklessly through the cosmos merely to live the way your ancestors lived? Was your need to feel dirt beneath your feet so great, so overwhelming, that it justifies the slaughter of eighty-four hundred lives?"

Stephen opened his mouth—and nothing came out but a soft choking sound. He remembered the devastation he'd seen. He remembered the bodies. And he could give no answer to Rillial's demand.

But Cecilia was not so speechless. "Now just wait a minute," she protested. "Just because you don't like living on planets doesn't make it immoral to do so. I refuse to allow my crew to be convicted due to nothing more than bigotry!"

Rillial glared at her. "It may not be immoral, but was it necessary? Living in a constructed world would not have killed you." She turned back to the tribunes. "But the humans' rejection of that option *did* kill eighty-four hundred Chirrn."

"We have a right to live in whatever way we choose!"

"The rights of one being do not include the right to destroy the lives of other beings!" Rillial cried, her voice ringing through the tribunal chamber. "You cite free choice as your only reason for choosing planets; for needing ramjets. But that is not enough reason to justify the destruction of an entire nation! It is *not!*" Rillial lowered her brown-maned head, covering her eyes with her hands, and struggled for breath.

This time, instead of a furor, a ringing silence filled the courtroom. The silence was finally broken by whispers between the tribunes and the arbiter, and then by the arbiter's voice: "The tribunes will now recess to deliberate this case."

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When court resumed two hours later, the head tribune stared gravely down at the humans. "It is a basic principle in both Chirrn and human law that the rights of the individual cease to be absolute when they threaten the rights or safety of others," he said. "Thus, it is the finding of this tribunal that free choice of habitat is not sufficient cause to justify the killing of eight thousand three hundred eighty-seven adults and children and the destruction of their nation. There were other viable alternatives to interstellar travel by ramjet which the defendants could have employed. Therefore the destruction of Lesshchi was avoidable and unnecessary. Therefore the defendants are culpable for its destruction." He rose. "This tribunal will adjourn for eight time-units, after which we shall reconvene for sentencing proceedings."

As the chamber emptied, Cecilia stood rooted to the floor, eyes wide in outraged shock. Stephen stood beside her, just as immobile . . . but showing only resignation.

Cecilia paced out the limits of their cell like a caged tiger. "They can't do this!" she cried.

"Cecilia . . ." Stephen sighed. "They're ten thousand years more advanced than we are. They can do whatever the hell they want to us."

"I won't have that kind of defeatist attitude! And I won't let my crew be condemned as a result of the Chirrn's bigotry." She paced some more. "We need to contact Arachne somehow. If we can get her to focus her lasers on Shilirrlal—"

"Are you *crazy*?!" Stephen cried. "You want to commit eight thousand *more* murders?!"

Cecilia glared at him. "Neither accident nor self-defense is murder. Besides, only the threat will be needed. We wouldn't actually do it."

"And what if they call our bluff? And even if they don't, how will the Chirrn see us then? As conquerors, destroyers, willing to cut down anyone who

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impedes our expansion into the universe. What will they do to Sol System if they decide we're that dangerous?"

Cecilia took him by the shoulders. "Stephen, listen to me. I know you're upset by all that's happened. Your compassion for the dead of an alien race is admirable. But their deaths are not our fault. The tribunal's decision is wrong, immoral. They're condemning us just because our beliefs differ from theirs. And I can't sit still and accept that. I have a responsibility for the safety of my crew and the success of our mission."

"And what about your responsibility for your own ship's wake?"

"What?"

"Isn't a captain supposed to consider herself responsible for the consequences of her vessel's passage? Isn't she supposed to take responsibility for all beings affected by her command?"

"Stephen, accepting responsibility is not the same as giving in to persecution! They're wrong to blame us for this!"

"Or maybe you just want to avoid the blame for it!" He pulled away from her, then faced her again after a moment. "Frankly, Cecilia, I feel we *are* responsible for those deaths. The Chirrn are right! We *didn't* have to build a ramship and race through the universe at ridiculous speeds. There are other options. We could've built more habitats. They still are building more habitats. On Luna, Mars, the Belt, the moons of Jupiter and Saturn . . . there's enough room in Solsys to hold a hundred billion people or more! And people thrive in artificial environments. It shouldn't matter whether the horizon curves down or up. It's not a cause worth destroying a nation over. Is it?" He cried out to all the prisoners. "*Is it?!*" He was met with only the echoes of his own voice.

Cecilia glared at him in contempt. "It wasn't our fault, Wong. We weren't responsible."

He met her glare in kind. "Keep telling yourself that, Cecilia. Maybe someday you'll convince yourself it's true."

* * *

"We understand that you are unfamiliar with our principles of justice," the head tribune told the defendants gathered in the courtroom. "Rest assured that we do not believe in punishment purely for the sake of retribution. Meeting destruction with destruction is wasteful and pointless.

"Those who commit destructive acts are required to compensate for them by doing constructive service. By making positive contributions, they repay for the damage they have done.

"It is the judgment of this tribunal that the forty human personnel of the ramship *Arachne* shall be imprisoned for the remainder of their lives in a research institution, where they will be studied by Chirrn scientists. By thus providing knowledge, you will repay your debt."

"That's barbaric!" Cecilia cried. "You have no right to treat sentient beings as lab animals!"

A pair of guards approached her menacingly with stun-sticks. "The prisoner will remain silent," the arbiter ordered.

"Thank you, arbiter," the head tribune said, before addressing the humans once more. "The experiments will be nondestructive and largely sociological in nature. You will not be subjected to cruelty. You will, however, not be free to refuse the experiments or to leave the facility. But such is the nature of imprisonment.

"As to the ramship *Arachne* herself, she will be stripped of her potentially destructive components and will be studied by Chirrn cyberpsychologists, to explore the ways in which humans have developed the cybernetic sciences. She, too, will contribute to our knowledge of the universe. You will be allowed to communicate with her as you desire.

"These judgments will be carried out immediately. The humans will be transported—"

"Um—Your Honor . . . Honored Tribunes?" Stephen interjected.

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"Yes, Stephen Jacobs-Wong?"

"I wish to make a plea. Not on our behalf . . . but on behalf of the six hundred human embryos being carried on *Arachne*."

The tribunes looked at each other interestedly. "Please proceed."

Stephen took a moment to choose his words. "Each of those embryos has the potential to grow into a live human being, to live a full, normal life. None of those potential people has committed any crime. None of them has ever lived on a planet, except as an insensate cell. Surely they have a right to live, and to live in freedom. Surely they should not be prevented from being born, or born into captivity, because of our actions."

The tribunes discussed it briefly. "This is well said. We direct that the embryos shall be allowed to be born, under the guidance of *Arachne*, and raised on Shilirrlal."

"But that's not enough, Honored Tribunes. Our young are very dependent upon their parents for the first several years of their lives. They need human parents or parent-surrogates to help them develop their abilities, to provide them with basic socialization. Neither the Chirrn nor Arachne could fulfill this role sufficiently. Human children need human parents. And how would it affect them if the only others they knew of their own race were nothing but imprisoned criminals, or laboratory subjects?"

Stephen lowered his head. "Honored Tribunes, I do not seek leniency for myself. I was responsible for this mission, I was the one who started it all. I feel . . . profound guilt for every one of those eighty-four hundred lives, and if it were just me I'd willingly accept your punishment. But the embryos, our potential children . . . they need us. And they need us to be free to raise them in a healthy and loving environment. So . . . isn't there any arrangement that could be made?"

The tribunes discussed this for a long time. As this went on, Stephen looked over his crewmates. There was a wide range of emotions on display. Most showed signs of the same grief Stephen felt. It made him proud that so many of his fellow humans could grieve for aliens as much as for their own. Many of the crew showed renewed hope at Stephen's proposal, hope for their own freedom, hope for their children yet unborn.

But some glared at him bitterly, resenting his admission of guilt, his statement that he would accept their punishment were it only for him. Some showed fear at the aliens' power, anger at their imposition, dismay at the impending imprisonment. And none showed these emotions as intensely as Cecilia LoCarno, his good friend. As Stephen looked into her eyes he realized that friendship was probably gone forever.

Finally the tribunes addressed the chamber once again. "The finding of this tribunal was that the humans' planetary bias was the underlying cause of Lesshchi's destruction. Therefore: any humans who will renounce a planetary existence, who will sever all ties with planet-dwellers and those who associate with them, will be welcomed into Chirrn society. You will be given a homestead on Shilirrlal, or another Chirrn habitat as you choose, where you will be free to raise your children and contribute as equals to Chirrn society, thus repaying your debt. Those who do not renounce planetary existence will contribute instead as research subjects. You may have time to discuss this decision among yourselves."

As the humans gathered together, Cecilia glared angrily at the look on Stephen's face. "You can't actually be considering their offer! Win your freedom by renouncing your values and embracing theirs? What gives them the right to demand such a—a Shylockian surrender?"

Stephen sighed. "Cecilia, they're not asking us to change our religion, just our residency. Besides, they're the only law

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around. The crime was committed in their territory—hell, it was committed *against* their territory—and that makes us subject to their laws.

"Look, I'm not happy about it. But we're convicted criminals under their law, and we can't expect to walk away scot-free. And this way, at least we get to raise our children in freedom. Just not where we expected. Personally, it feels like getting off easy. But I'm going to take their offer, for the children's sake."

He stepped forward to face the tribunes. "Honored Tribunes, I accept your proposal. For the sake of our children, I renounce my planetary existence and ask that you let us live with you among the stars. I ask anyone else who will make this pledge to indicate it by stepping forward to join me."

The first to join him was Zena Bhatiani, who stepped forward without hesitation. "Live among an ancient alien culture?" she whispered up to Stephen. "That's better than any wilderness planet for me."

Others stepped forward in a slow trickle, some singly, some in groups. After long moments of stepping forward and retreating, Chaim Silbermann finally advanced to join the others. "Someone's gotta be free to take care of *Arachne*," he shrugged. Finally, twenty-six others stood with Stephen, and only thirteen remained behind—with Cecilia LoCarno at their center.

"The tribunal accepts that those who stand with Stephen Jacobs-Wong have renounced their planetary existence," said the arbiter. "They are now free to live among us. The others will be welcome to join them at any time in the future if they will make the same renunciation."

"Never!" Cecilia cried. "We have the right to live as humans!"

Stephen saw something snap in her eyes at that moment. Lunging forward, she snatched the stun-stick from a guard and swung it wildly, knocking down the guards near her. She made a run for the exit . . . but was promptly tackled from behind by the very guards she thought she'd stunned. As they dragged her forward before the tribunes, she was muttering weakly, "How . . . ?"

"Cecilia . . . " Silbermann said softly. "They're ten thousand years ahead of us. Even we have weapons that only respond to their owners."

"You don't have to be so smug about it," she snarled, throwing him a savage look.

Silbermann gazed at her sadly. "I'm not. I wish you could see that."

"Please, Captain LoCarno," the arbiter said. "Do not make this difficult on yourself. You cannot escape us."

"But I'll never surrender to you! I won't throw away my humanity like these traitors!"

"Cecilia, please understand," Stephen begged. "It's for the children."

She shot him a look that should have vaporized him like Lesshchi. "It's for yourselves."

"No," Stephen whispered.

Her eyes went from deadly hot to deathly cold. "You're all traitors to your race. I want nothing more to do with you." She almost seemed glad when the guards took her away.

Rillial gazed after her curiously. "Pitiful," she said. "To be so fanatical in her planetarism."

"I don't think that's it," Stephen said sadly. "I think she just can't accept being responsible for the loss of eight thousand lives. It's just too big a tragedy; she can't live with the guilt. So she'll never be able to admit to guilt."

The refugee examined him. "But you can."

A tear came to Stephen's eye. "Barely. Rillial, I hope you can forgive me . . . forgive *us* for what we've done." He sighed. "I don't know if I'll ever be able to forgive myself."

Rillial just stood silently for a long moment. Then she said, "The important thing now is to decide what to do about other human ramships that might be out there. It is more important to prepare for the future than to dwell on the past."

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Stephen nodded solemnly, recognizing that it was the closest thing to forgiveness that Rillial would ever provide.

The arbiter, having left his podium, joined them. "Are there many other human ramships in space?"

"Well," Silbermann answered, "there wouldn't be that many. We've only been using them for a few decades. I daresay you wouldn't find any more than . . . ten parsecs from Sol."

"Excellent," the arbiter said. "It should be easy enough to locate all such ships and warn other Chirrn habitats to avoid them."

"Wouldn't that take a long time? Even centuries?" Stephen asked.

"We do possess trans-lightspeed spacewarp drive," Rillial told him. "Our habitats drift slowly, but we travel between them routinely in transport ships." Apparently, now that the humans had joined Chirrn society, they could be let in on their secrets.

Silbermann's eyes widened like a child discovering the Planet of Chocolate. "Warp drive? Really? Oh, well, it should've been obvious, you've got gravity control, so why couldn't you warp space, but how do you deal with the negative energy problem? How do you get around the light compression in the forward warp, see anything in front of you? Or is it the Alcubierre model at all, do you use some other—"

"Chaim!" Stephen chuckled. "Settle down. You'll have plenty of time to learn about it." But then his own eyes widened, and he turned to the Chirrn excitedly. "But this could solve the problem! If you went to Solsys, contacted them, shared your warp technology with them, it would eliminate the danger of ramjets completely! There wouldn't—"

"Take care," said L'chellin, who had joined them. "Remember, you have renounced all ties with Earth, and with all spacegoers who have ties with Earth. Do not forget so soon what that means."

"You must accept," the arbiter added, "that you are no longer a member of the human community. Their interests are no longer yours."

With that, the Chirrn left them. Stephen and the others stood there, alone in the echoing tribunal chamber, absorbing their new status in life. They were free to leave at any time, into a world they barely knew. For now, they remained.

"No longer members of the human community," Silbermann breathed. "Does that mean we aren't human anymore?"

"No," Zena Bhatiani said. "We're just not Terrans anymore. Not Solar humans, or planetary humans. We're star-people now."

Silbermann scoffed. "Sounds poetic, sure. But it's not by choice." He shook his head. "At least the captain still belongs. She may not have her freedom . . . but she's still a member of the human race."

"What good is it to be human without being humane?" Stephen whispered. "We've done this to repent for our crime, for causing a disaster we didn't have to cause. We owe it to the Chirrn to make up for the loss we caused them, by joining their society and helping them to build and grow.

"And, most of all, we've done this for the sake of the unborn humans in our care. This is the only choice we could make, for their sake. It's not an ideal situation . . . but it's the only one that I, for one, can live with."

Zena looked up at him searchingly. "But when our children ask where we came from . . . what do we tell them?"

"We tell them the truth," Silbermann said with certainty. "Just like my parents told me. My father's ancestors murdered my mother's ancestors in the Nazi Holocaust. They didn't keep that from me. No, they made sure I knew . . . so that I could make sure it never happened again."

After a long silence, Stephen spoke again. "Come on, my friends. We set out to build a new world for ourselves. And now it's time to begin." ■

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Playing God, Sarah Zettel, Warner, $21.50, 416 pp. (ISBN: 0446523224).
Aftermath, Charles Sheffield, Bantam, $13.95, 368 pp. (ISBN: 0553378937).
The Shapes of Their Hearts, Melissa Scott, TOR, $22.95, 301 pp. (ISBN: 0-312-85877-9).

Darwinia, Robert Charles Wilson, TOR, $22.95, 320 pp. (ISBN: 0-312-86038-2).
Child of the River, Paul J. McAuley, Avon, $14, 306 pp. (ISBN: 0-380-97515-7).
The First Immortal, James Halperin, Ballantine / Del Rey, $24.95, 342 + x pp. (ISBN: 0-345-42092-6).

Masque, F. Paul Wilson and Matthew J. Costello, Warner, $23, 342 pp. (ISBN: 0-446-51977-4).

Going Home Again, Howard Waldrop, St. Martin's, $20.95, 223 pp. (ISBN: 0-312-18589-8).

The Angle Between Two Walls: The Fiction of J. G. Ballard, Roger Luckhurst, St. Martin's, $39.95, 213 + xx pp. (ISBN: 0-312-17439-X).

The Year's Best Science Fiction, Gardner Dozois, ed., St. Martin's, 672 pp., paperback $17.95 (ISBN: 0-312-19033-6), hard cover $29.95 (ISBN: 0-312-18779-3).

Sarah Zettel's first two novels—*Reclamation* (reviewed here in June 1996) and *Fool's War* (reviewed here in May 1997)—established her as a writer to watch, a writer with a gift for character and situation, a writer who could keep you turning those pages as breathlessly as ever you have before.

Rush right out and grab her third, for she hasn't lost it. **Playing God** gives us the world of Dedelph, whose natives—humanoids who begin life as sentient females but turn into mindless males later—are hot-tempered, paranoid, murderous racists. They have poisoned their world in endless wars of mutual extermination. Most recently, one group released a plague that mutated to claim about half the population. Refugees have settled on Mars, where Lynn Nussbaumer has helped them terraform a crater. They have also learned to live together in peace. And they rejoice when those back home hire a human corporation—Bioverse—to restore their world to something like its pre-war state. .

Bioverse hires Lynn Nussbaumer to organize the first step, relocating the Dedelphi from their world to vast cityships in space. The admittedly grandiose plan is then to release tailored microorganisms to devour toxins and cleanse air, water, and soil. Bioverse will take its pay in whatever new microorganisms it can find (biology, says Zettel, is the only nanotechnology that really works). Later it will reconstruct Dedelph's biosphere and repatriate the natives.

But—Dedelph is an exceedingly political world. It doesn't take long for its paranoid factions—who do not trust the humans' good intentions, or that their local foes will not find a way to take advantage of the situation—to find ways to mess up the plan. Humans have their politics too, and one of Lynn's old friends, xenological researcher Arron Hagopian,

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is quick to draw parallels between what Bioverse is attempting and the mess another corporation made when it looted a different world's biosphere.

The final point is fairly simple: Local control is crucial; it is not enough to say, "Save us!" and then just let the paternalistic, colonialist humans take over. Getting there is absorbing and exciting, with many a reminder that aliens are people too.

If you like hard-SF disaster novels, you'll love Charles Sheffield's **Aftermath**. The gimmick is a supernova—nearby, Alpha Centauri, and never mind that the Centauri system just can't produce such a thing. Sheffield knows that, he mentions it, and he tells us that very possibly there's a really nasty fellow in the stellar neighborhood, but right now we've got more immediate problems than that to worry about.

For instance, the supernova burns about as brightly in the southern hemisphere sky as the sun. This is initially rough on southern countries—heat waves, droughts, and finally megafloods, not to mention a wee bit of Antarctic melting—but it disrupts global weather patterns too. A little later, the shell of gas expanding around Centauri thins enough to let the gamma burst through, and ZAP! We have a massive EMP (electromagnetic pulse) that fries virtually every integrated circuit chip on the planet. And since the time is 2026, that means the instant death of cars, planes, power systems, databases, communications systems, medical equipment, etc. Civilization drops in its tracks.

But it refuses to die entirely, thanks to the efforts of a few determined folks, not all of whom are very nice. Meet President Saul Steinmetz, who will do his darnedest to get things organized. Meet Art Ferrand and company, subjects of a new cancer therapy that needs constant monitoring (by devices that use chips, of course) to ensure that it does not go awry; they will heist from prison researcher Oliver Guest (condemned to sleep for centuries for murdering adolescents), whose expertise in cloning and genetic engineering lies behind the therapy (and is crucial to his plans for those murdered children), and persuade him to help them out. Meet the Legion of Argos, also liberating their sleeping prophet and planning to cleanse the Earth of all races besides the fanatic white. Meet a pair of congresscritters who think the disaster is a God-given opportunity for an American empire to rule the world.

Meanwhile, here come the intrepid Mars explorers, on their way home to a space station that is now dead (those chips again). One of them sees that the worst effects of the supernova are yet to come, fifty years hence, riding a planet-sterilizing blast of charged particles. Not that he can do much, when he and the surviving explorers wind up prisoners in the Legion of Argos's underground redoubt.

This one's a grand read. Don't miss it, and hope with me that Sheffield does the sesquicentennial sequel. I want to see if his scheme for protecting the Earth works, and then to see what shows up after the particle blast.

Melissa Scott's **The Shapes of Their Hearts** is not one of her most ambitious titles, but it is nevertheless readable, entertaining, and interesting. The chief setting is Eden, a world dominated by a religious group that long ago preserved its founding demagogue in the form of the Memoriant, an artificially intelligent computer program that more or less faithfully preserves the salient features of that demagogue's belief structure. The group's beliefs declare anathema all clones (soulless) and all those who travel between the stars by matter transmission (which destroys souls). When they decided to spread their beliefs abroad by exporting copies of the Memoriant to foster terrorism, they were severed

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from the computer Net that knits the worlds of civilization together and blockaded.

Yet the terrorism continues. When it strikes the world of Jericho, it is not long before Anton Tso—a clone of Henry Zou, and the Zous are known as fixers—is sent to Eden. His true mission is to obtain a true copy of the Memoriant for the sake of certain of its abilities. He is, of course, seen by the Edeners as coming for revenge, to destroy their god.

He is promptly kidnapped, plugged into virtuality so the Memoriant can appraise him and his motives, and trapped when things immediately go wrong. Meanwhile, his injured security aide is finding local help in the form of a pair of on-the-outs cops whose partner had joined the True Believers and is now among the kidnappers. The reader is treated to a tour of the local culture and given a number of hints that the local Net is troubled. The Memoriant is there, but so are other things.

Tso is learning much the same, from the inside. The Memoriant is troubled by an enemy it does not understand. When that enemy appears in virtuality, things go awry. And there is more. . . .

What's going on? Given what Scott has shown us before of her interests, I don't cheat you by mentioning independent artificial intelligence. Alas, I think she has overreached a bit, for one of those AIs seems more AI than its function requires, was generated too easily, and suffers from a slight case of the cutes.

Still, very readable.

Robert Charles Wilson's latest is a hard one to describe without giving away too much, but I'll try.

Darwinia's premise is that in March 1912, the sky glowed with a fabulous aurora. When the glow faded, Europe was no more. Where there had been millions of people, cities, ports, factories, roads, rails, monuments, and ancient ruins, there was suddenly only forest. And forest of a strange kind, at that. The trees looked and smelled very different from anything humans had ever seen before. So did the ground cover and other plants, while the animals were fur snakes and sea monsters, ten-legged "insects" whose bite was deadly, and more. It was as if a piece of another world had been grafted onto the flank of the Earth. Telescopes suggested that something similar had happened to Mars.

At the time, Guilford Law was just fourteen. A few years later, he joined the Finch expedition, aiming to explore the European continent, as a photographer. He parked his wife and daughter in the new London rising from the mud beside the Thames. Then he—as well as the rest of the expedition—vanished, the apparent victim of American attempts to stake out a new "New World" and English attempts to ward off the Americans by running guns to partisans on the mainland.

Meanwhile, strange folks are appearing in America and elsewhere. Meet Elias Vale, who carries within him a "god." When the god comes to the surface, Vale is able to find lost objects and put people in touch with their departed loved ones. He is also immune to harm, and if his god's intentions are suspect, well, his own morals are pretty slippery. No problem.

Meanwhile, Guilford Law is stalked by a ghost, himself in the tatters of a World War I doughboy outfit, who tells him that he is significant because he already died (in the world we know), yet is alive (when Europe was changed, so was history). Guilford doesn't want to admit that significance. All he wants is a life. But in time he is forced to accept the grip of destiny and go to war against . . .

What? The tale is not yet half told when Wilson supplies an explanation. At the end of time, when the universe is winding down, the godlike (to us) intelligences of the era constructed an Archive that would store and replay the

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history of the universe, including planets such as Earth and individuals such as Guilford Law. Unfortunately, it was almost immediately infested by "subsentient virtual entities, relics of a war that had devastated a distant galaxy long before [who] were using the Archive as a platform to preserve their algorithms against thermal death. They lacked moral regard for any entity not themselves, but they were fully aware of the purpose of the Archive and of its designers. They had not simply captured the structure, they had taken it hostage." Changes were being made. Past lives were being converted from records to new lives, living within the Archive, and the Archive's masters are at war to expel the virtual foe.

Do they succeed? How? And what is the crucial difference between a world that is real and one that is "merely" a faithful replica? I'll let Wilson answer such questions. All I can do now is promise that he will—as always—satisfy.

Paul J. McAuley's **Child of the River: The First Book of the Confluence** seems to owe a fair amount to Gene Wolfe's Books of the Long and New Suns. In the far, far, distant future, McAuley tells us, there is a world called Confluence occupied by ten thousand bloodlines, the descendants of animals given sentience and human form by the long-gone Preservers who also had Confluence built; there are also sentient machines. What he shows us is a river and its banks, stretching for what seems forever, with eons-old cities on its shore. There is no mention of anything very far beyond the banks—in due time he even calls Confluence a habitat—except for the galaxy overhead, whose stars the Preservers had literally rearranged before, says legend, they dove into a black hole to await the end of time. Occasionally, Confluence is visited by ancient starships whose contemporaneity has been time-dilated out of step with their own age. In the great city of Ys, factions of bureaucrats war with each other. There is also war far downriver, with the heretics whose proper reverence for the Preservers was subverted by the Ancients of Days, who came on one of those starships from a time long before the Preservers rearranged the Galaxy and built Confluence.

The sense of a thickly layered past is as palpable as anything Wolfe ever managed, especially in the City of the Dead, that long stretch of the riverbank where people built their tombs for eons. Now the tombs have all been looted. The people of Ys float their dead down the river, and here comes an unusual coffin, a white boat bearing a woman with a baby at her breast and surrounded by a cloud of glowing machines.

And Lo! the baby lives. Lift him out, gently there, take him back to shore and give him to the Aedile, chief bureaucrat of Aeolis, a small town nigh the City of the Dead, to raise as his son. Name him Yamamanama, Child of the River, watch him grow and develop an unusual skill or two, a match for no known bloodline, and as he approaches maturity . . .

Dr. Dismas, apothecary of Aeolis, plots to steal the boy away for his masters in Ys. Mercenaries appear, and so do mysterious forces whose interference permits Yama to escape. Soon thereafter he acquires an ancient and powerful weapon, learns just a little about his bloodline and the aura of destiny that surrounds him, and embarks on what bids fair to be a career of wide-ranging adventure that may or may not end in saving the Confluence from a disaster that is so far only hinted by a slow decline in the river's level.

I say that McAuley owes something to Wolfe, but he is not imitating, not ripping off. Rather, I think, he has admired themes and settings and atmospheres and endeavored to see what he can do with something similar. The result is quite interesting—a confluence in its own right—and very readable. One cares about Yama's fate and yearns

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for McAuley to twitch aside a bit more of the veil of mystery that conceals the nature and history of his creation. You'll enjoy this one, and you too will look forward to future volumes in the series.

You are surely aware of cryonics. This is the idea that if you are frozen in liquid nitrogen immediately after death (or better, before), your remains can be preserved until some future day when technology has advanced to the point where whatever killed you can be repaired, as can the damage from the freezing itself. And if you have only enough of the ready to freeze your head and brain, that's okay, for eventually technology will surely reach a point where the missing rest of you can be cloned.

The freezers exist. Some folks have already entered them. But cryonics is clearly a hope, a faith rooted in immense optimism about science and technology and continued progress. This is a hope and faith shared by many in the SF world, and here is James Halperin's **The First Immortal** to tell us all about it.

The tale's central character is Benjamin Franklin Smith, a physician who discovers cryonics and chooses to be frozen. The rest of his family thinks this a waste of money, one of his daughters (with her shyster husband) sues to get the money, and he's nearly thawed. But Ben has friends to defend his frosty corpus, and in due time . . .

Step by step Halperin lays out the technological developments until eventually nanotechnology makes possible revival and the fulfillment of all the cryonics dreams. This is the bulk and the point of the book, hardly a novel at all but a techno-optimist's tract whose major flaw is the inescapably magic-wand character of the enabling nanotech. I'm a techno-optimist myself, but I really do not think nanotech will develop in time—if at all—to save us from the population-food-resource crises looming over us in the next twenty to thirty years.

If you want a nice chase adventure and aren't bothered by bafflegab science, grab **Masque**, by F. Paul Wilson and Matthew J. Costello. The basic gimmick is that in a pretty grotty future, civilization is dominated by corporations or "gloms" that use genetically altered "mimes" for grunt labor. Mimes, cloned from vats, have a special chromosome that makes them able to take alternate forms, even those of other humans, by mimicking their genomes even to the point where their own mime chromosomes vanish (they somehow retain the ability to repeat the trick, but never mind that).

Now meet Tristan, mime secret agent who has only one more mission to go to earn "Selfhood," promotion from slavery to humanity. That mission is to infiltrate a competing corporation and return with a secret that will make his own outfit king of the hill. However, all is not what it seems—not even that promise of Selfhood—and Tristan is soon spang in the middle of a tangled web of romance, intrigue, insurrection, and attempted genocide.

It's a fun story, and it would make a fun movie with great visuals—especially the morphing of mime actors into gladiators, monsters, and puddles of goo. But don't expect to see it on any award lists.

It has been a while since a Howard Waldrop book last came my way (*Night of the Cooters*, 1990), but here is **Going Home Again**, another collection of Waldrop's patent short fiction. And it is all strange stuff, for this fellow specializes in setting popular culture, social trends, and historical and literary figures out of time and out of joint. The title story puts Thomas Wolfe and Fats Waller on a 1940 zeppelin, in a world without War II. There's an alternate *Christmas Carol*. There's the end of time, first glimpsed by H. G. Wells but

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here related by a local. There's the truth behind all those ancient Little Moron jokes. And there is what I think the absolute gem of the crop, "The Sawing Boys," in which a handful of Runyonesque rum-runners meet hillbilly country music at the dawn of the age of radio. This alone is worth the price of the book, justifies Waldrop's reputation, and will delight your soul.

Roger Luckhurst's **The Angle Between Two Walls: The Fiction of J. G. Ballard** takes a fair shot at explaining why J. G. Ballard has never been a very popular writer, in SF or out of it. In his own words (from the Preface): Luckhurst is trying "to describe and analyze the unease felt when reading [Ballard's] body of work, . . . a corpus compelling to some, repelling to others, yet always provocative . . . . [T]he framings of his work have remained undecided (and undecidable) throughout his career, such that multiple, often incompatible, Ballards have proliferated . . . . [I]t seems to me that Ballard renders visible the space *between* frames, exposes the hidden assumptions behind the secure categorizations of literature and literary judgment. . . . [At the heart of the issue is]-the enigma, the core of unreadability, that disturbs definitional frames and propels the interminable work of critical analysis."

If Ballard is that unreadable, this is clearly a book for professional literary sorts, academics who assign unreadable texts to their students as a rite of scholarly passage. The rest of us would surely rather read an analysis of a more readable writer such as, say, Ursula K. LeGuin.

Gardner Dozois's fifteenth annual **Year's Best Science Fiction** is now available in both paper and hardcover. As usual—and I hardly need to say more than those two words—here is the premier compendium of short work, over a quarter million words of 1997's best, drawn from the traditional print and the newer online magazines. Familiar names include Robert Silverberg, Paul J. McAuley, Howard Waldrop, Nancy Kress, Greg Egan, James Patrick Kelly, Michael Swanwick, Robert Reed, Brian Stableford, Ian MacLeod, John Kessel, and Gregory Benford.

The part of the book most worth reviewing is surely the introductory essay that sums up the year in SF, which is not available elsewhere. Here Dozois briefly recounts what's been happening in the various areas, tries to put it all in some sort of perspective, and succeeds admirably. For instance, he is dead on when he hints at the impending demise of *Omni Online*, which was actually announced just a few days ago as I write this. I hope his evaluation of the prospects for other online fiction sources such as *Tomorrowsf* (http://www.tomorrowsf.com) and *Mind's Eye Fiction* (http://tale.com/genres.htm) is less accurate (after all, I'm involved in both of those). ■

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BRASS TACKS

Dr. Schmidt:

As a long-time reader of *Analog* (since 1969), I enjoy reading the editorials. But this time, I got the feeling that your experience with gravel (and other construction materials) and its economics may be limited.

It doesn't take much of a mountain (preferably a glacial deposit where Mother Nature has done the hard work of breaking and sizing) to produce a whopping amount of gravel. However, a scenic view requires one very large, if not a whole range of mountains, to produce a satisfying experience. A big difference in resource requirements. I don't know about those economics.

Gravel is a marginal economic product. In other words, gravel is pretty cheap; the expensive part is moving it to market. A good rule of thumb for the maximum radius of delivery is one hundred miles (a big dump truck costs about $50 per hour to operate more or less—full or empty). So, gravel sources have to be relatively close to their end markets. However, Mother Nature has the ultimate word where material suitable for gravel production is found. That can make job relocation a tuffy.

You commented: "They may be thinking only of economics." The physical volumes of rock (material suitable for making gravel) on the Earth are staggering. We will not run out of gravel; we will not even scratch the surface in any significantly measurable fashion based upon total land area. It's a slam dunk bet to say there is more land area dedicated to amusement parks and shopping centers (another form of entertainment) than gravel quarries. And then came the comment: "There is a lot of gravel in the asteroids." At what cost? At the quarry, gravel production costs are from $0.50-2.00 per ton. The rest is transportation. Astero-gravel? Naw, not a chance!

In economics, experience has taught us that as scarce materials are used up, cheaper substitutes are found. And, as technology advances, fewer resources are required to make or find the substitutes. Nothing equals economic necessity as the driving force to reduce the consumption of energy and resources.

As for recycling, the industrial and construction sectors lead the way. For example, much of the asphalt paving that is removed ("planed") from the surface of roads is used to make new paving material; concrete from the demolition of roads and buildings is crushed to recover the steel reinforcing and make aggregate ("gravel"). And the foundry industry obtains over 90% of its metal from scrap. In tonnage, nothing else even comes close.

You stated that we cannot continue to build more and more houses and business places indefinitely, which shall lead to shortages and a lower quality of life. That sounds like the Meadows "Club of Rome" analysis which is generally discredited by economists as being too simplistic. Linear extrapolations don't work well.

The statement, "That work still consumes resources, and so a destructive—and quite unnecessary—cycle perpetuates itself" fails to take into consideration the changing nature of work. As income rises, fewer people are involved in the

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production of goods—more people become service providers. Over time, the amount of resources required per unit of production has and continues to drop. The mechanism driving the reduction in consumption of resources is the price mechanism—a very effective means of rationing scarce resources.

Industry now recognizes that resources are more costly, i.e., scarcer. As a result, industry uses less resources per unit of production, recycling more materials back into production. The invisible hand of economics is at work, forcing us to do more with less, substituting cheaper items for the more costly.

Without question, as income levels rise, the birth rate declines. This inverse relationship between wealth and the birth rate has been confirmed by data from all areas of the world. As the standard of living rises around the world, it will move us into an era where we are conservative with our resources, where services provide more work than the production of goods.

As for the gravel miners, well, it's human nature to protect your job from someone who would put you out of work because they want to enjoy the view once or twice a year. Surely a compromise can be struck that provides protection for the environment without putting marginal workers on the street. I sure hope so.

Yes, we'll eventually go to the asteroids, but I don't think it will be for gravel.

MALCOLM B. WOOD, P.E.

Dear Stan,

The last three paragraphs of your editorial in the May issue of *Analog* speak of an idea that has intrigued me for the last few years. I've been asking intelligent people, "What is the purpose of our economy, and is it achieving that purpose?" Their answers reveal that everyone believes the economy to be imperfect, but very few can picture a totally different system, only incremental improvements.

Everyone has bought a large bagful of notions, and knows that some of those notions contradict each other, and they look around but do not see anything better. Any one better idea might meet with approval, but is usually considered impossible because it won't fit in with the existing system. Kind of like computer software. Hmm, that might be an interesting analogy. . . .

How often do SF writers explore alternative economics systems? Not just different in terms of who controls the money or how it gets used or how money relates to social classes, but really different, like totally getting rid of it. I remember an *Analog* serial in 1985 or '86 in which one extraterrestial species based their economy on the propagation of humor. In one episode of *Star Trek: The Next Generation*, a twentieth-century man who was frozen upon death, upon being revived, was anxious to find out how his investments have done over the centuries. He discovered that no one in the twenty-fourth century needed the concept of money. (I wonder if bank ATM machines are another SF inspiration? But those are mere gadgetry to handle the mechanics of the economic system.)

I used to prefer "hard SF" just for the technological marvels, and I've gone to grad school to study physics, but I'm becoming more and more interested in economics. Science Fiction writers have inspired communications satellites and exploration robots on Mars. Now they must inspire new ideas of cultural organization to help us all get beyond old economics ideas, and show us worlds where good things may be accomplished with only effort and not be held back due to lack of funds. In more detail than anything written in the past, which has mostly offered only a taste of non-economic societies, and with that exquisite balance of realism and wondrous vision achieved by the best, I'd like them to show us another system of society, and

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how everyone in such a society would be happy with it. Would people who "work" (whatever that may mean) be jealous of those who don't? Would power-seekers want to find ways to thwart the unrelated fruitful activities of others? Lacking money, what instruments of control would they use instead? If powerful technology can reduce greatly the need for jobs, can it also reduce the desire of some to control others? Was it that, and/or something else, that was behind the origins of all economics systems?

And, what would all the lawyers do?

Daren Scot Wilson
darenw@pipeline.com
www.newcolor.com
2076 Pauline Blvd #TB
Ann Arbor, MI 48103

Dear Stan;

Your May editorial "Snakes or Paychecks" revived thoughts I had had about the socioeconomic effects of advancing technology.

Some future development (nanotechnology is usually mentioned in this regard, but probably something as far advanced beyond *that* as modern microelectronics [as exemplified by the personal computer] is beyond nineteenth century precision machinery [as exemplified by the manual typewriter]) will make it possible for the entire world population to be maintained in a standard of living far beyond our imagination by fewer people than would want to do it for *the fun of it*. This will have profound effects on the "Judaeo-Christian" work ethic as well as leading to either sybaritic hedonism and/or utter boredom. The idea of jobs as an end in themselves, rather than as a means to an end, will become meaningless. As you mention in your editorial, we are already beginning to see such effects even from our present technology!

Stuart-Morgan Vance
700 Highland Avenue
Ashland, Ky. 41102-5244

Dear Stanley Schmidt,

I think you should let your environmental impact friends know some of the techniques used by an owner of land on your scenic mountain in New York State.

Recognize that the owner of the property in which the quarry is to be located may pay the hecklers. Expect that the environmental impact document which is necessary to activate such a quarry could have been identified as available for review, only in the little community in which the quarry is to be located.

The owners are within their rights to post the notice about the intention to activate a quarry only at the local rural post office, and then at points where it is hardly noticed. The owners may also own local businesses, and provide employment for local people, who are urged to support the owners intentions under threat of loss of local employment. The owners may also contribute significantly to local school and church activities for purposes of getting local support.

By avoiding any review of the preliminary and follow-on environmental impact documents, a biased, incomplete environmental impact document can be pushed through the local government with little criticism.

The point is that the outsiders need to provide support for the animals, trees, and scenic parts of the mountain, which can't review or comment on the environmental impact document. What are needed are critical reviews of the environmental impact document, and publication and distribution of the document to government and public agencies that are interested in discovering such environmental documents, so that they can provide critical comments. The owners of course, will attempt to minimize the publication and distribution of the document in the hope that a critical review never occurs or is presented too late.

I accidentally ran into the local at-

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tempt to activate a quarry in southern San Diego County. I drove around and contacted local parties around that quarry area, and found that almost nobody except the very local people knew anything about it. This included a nearby new housing development, the adjacent nearby towns, the local recreation vehicle campground, which was adjunct to the quarry property, yet which had been ignored completely in the environmental impact document, and the developers of an Olympic training center located about two miles away. The only notice given was at a one-room post office, which identified a meeting held at a local grammar school auditarium in the middle of the week at 8:00 PM. Eventually the environmentalists won, but it took some real effort.

HENRY M. SALISBURY

Dear *Analog*,

The Alternate View (May 1998) is mistaken.

In any win-lose situation, once you have selected an option, you have at that instant already either won or lost, with 100% certainty. The die falls when it is cast, not when you open your eyes to look at it. It is only your knowledge of the outcome which involves uncertainty.

When only two doors remain, and you now know that one of these two hides a prize, change doors if you feel like it, or stand pat if you wish. But there are no new odds involved. As between those two doors, your chances of winning are 50-50, but then, they always were. You now know what initially you did not know. But it is only your hopes that have changed—not your actual chances!

Ignorance of the outcome of a past event does not affect the past event. Statistics deal with uncertainty—and uncertainty is a state of mind, not a state of matter.

AL FONDA
649 South Henderson Rd. C-307
King of Prussia, PA 19406

Dear Dr. Shmidt,

I am writing to you regarding an article in your May 1998 issue of *Analog*, "The Permanent Alternative" by Jeffery D. Kooistra.

I am a member of Mensa and also belong to some other high IQ societies that Marilyn Vos Savant belongs to, so I am familiar with her answer to the three doors puzzle.

If you have three doors with a car behind one, and two goats behind the others, your chance of picking a car by opening one door is 1 in 3. If, however, the host picks one door and opens it, revealing one goat, then (even though this is not the door that you picked) you have two doors to choose from. This means that your chance of picking the right door is 1 in 2, or 50%. It's that simple. Whether you switch or not your chances are still only 50%.

CELIA MANOLESCO JOSLYN
1127 22nd St. #B
Santa Monica, CA 90403

Dear Dr. Schmidt,

I greatly enjoyed Jeffery D. Kooistra's May "The Alternate View." I, too, remember Marilyn Vos Savant's puzzle. However, I didn't agree with her then, and I don't agree with Mr. Kooistra now.

Several of my coworkers and I (all of us Ph.D.s in various aspects of statistical physics) attacked this problem when it was first published. Here are two different ways of showing that the odds are even once the host opens the door.

First, we should note that the best way to calculate odds is to list all possible outcomes, and find out which ones are favorable. For instance, the 36 possible rolls of dice are 1-1, 1-2, 1-3, 1-4, 1-5, 1-6, 2-1, 2-2, 2-3, 2-4 . . . 6-6. Two of these add up to 3, so the odds of rolling two dice and getting a total of three are 2/36. We can do a similar analysis in a more complicated case.

Let's call the three doors "A," "B," and "C." We'll assume the door is behind

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door "A." (If it's not, we can do the analysis again, getting the same answer.) We'll first look at the possible outcomes when you stick with your original choice (1st C=1st choice; DO=door opened; 2nd C=2nd choice; G/B=good or bad?):

1st C	DO	2nd C	G/B?
A	B	A	Good
A	C	A	Good
B	C	B	Bad
C	B	C	Bad

You win 50%. Note that there are two possiblities if you pick door A, but only one for either B or C. (The host won't open the winning door.)

Now let's look at the cases where you change your mind:

1st C	DO	2nd C	G/B?
A	B	C	Bad
A	C	B	Bad
B	C	A	Good
C	B	A	Good

Again, you win 50%.

Now let's examine a more abstract but more elegant argument. Let's start the game. You pick a door, and the host opens another one. Now a second contestant walks in. She sees two closed doors. Obviously, her odds of winning are 50%. But, her situation isn't really any different than yours. Although you got there by different methods, you're both in the same place: in front of two doors, one of which contains a prize. So, you both have to have the same odds: 50%.

The flaw in Mr. Kooistra's argument is "... that whole 2/3 chance of winning ..." What he missed is that there is more than one way of getting to that 2/3 chance. Sometimes the host can pick from two doors, sometimes only one. The only way to keep track is to list all the possibilities, as we did above.

All this being said, I still agree with the main point of the article: we all must be willing to consider a new argument, and change our minds if necessary. My own Ph.D. research in physics went down several blind alleys before it was successful.

Thanks for the great magazine.

THOMAS E. GIST, PH.D.

The author replies. . . .

So far, I've received letters from Westmiller, Vann, Foote, Sills, Manolesco, Gist, Wallewein, Morehouse (who wins the prize for the letter that most reminded me of the original note I sent to "Ask Marilyn" and to whom I'd like to say that I will cover alternative explanations for cosmological red shifts in some future column), Elliot, Fonda, Rayle, and Guy. I've been in touch with Westmiller, Vann, and Foote. Westmiller now agrees with me, as does Mr. Foote. I have yet to hear from Vann on whether or not he's changed his mind, too.

OK, seems that no one really disagreed with the point of the column—they just disagree with my answer on the puzzle. Most of the writers were geniuses or professionals of one kind or another. Well, I'm up in the IQ stratosphere, too, and one thing I know is that genius is no guarantee against blowing it, which these writers have amply demonstrated.

Lights please.

There are only 18 situations one need consider since it is the case, upfront, that the first door opened by the host after the initial guess is by no means at random. The host always, deliberately opens a door with a goat behind it to heighten tension and draw out the game.

With this in mind, consider that there are only six different kinds of players, and three different door arrangements. The first player is one who will guess door 1 and stay with her guess. The second player is one who will guess door 1 and switch. The third player is one who will guess door 2 and stay (and like that for the remaining three players). There are three initial door arrangements: prize, goat, goat; goat, prize, goat; and goat, goat, prize.

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Now consider the table below.

Player	Door 1	Door 2	Door 3
	PGG	GPG	GGP
1 keep	win	lose	lose
1 switch	lose	win	win
2 keep	lose	win	lose
2 switch	win	lose	win
3 keep	lose	lose	win
3 switch	win	win	lose

Now follow along kids. Let's look at what happens in the "2 keep" row. The player initially guesses door 2, but in the first column, the prize is really behind door 1, so the host opens door 3, the player stays with his original guess, and he loses. In the second column, he guesses door 2, the host opens either door 1 or 3 since both have goats, the player keeps door 2, and he wins. In the third column, he guesses door 2, the host opens door 1, the player keeps door 2, the prize is really behind door 3, so he loses.

You keep your original guess; you win one time out of three.

Let's look now at 2 switch. The player initially guesses door 2, but in the first column, the prize is really behind door 1, so the host opens door 3, the player switches to door 1, and he wins. In the second column, he guesses door 2, the host opens either door 1 or 3 since both have goats, the player switches to the unopened door, and he loses. In the third column, he guesses door 2, the host opens door 1, the player switches to door 3, where the prize really is, and he wins.

You switch; you win two times out of three.

Now, some of you encountered this puzzle for the first time in the same "Ask Marilyn" column that I did. She explained herself twice and now, from me, you have just had your fourth explanation. If you still don't get it then you're either just being stubborn or not looking at it "with fresh eyes". You've had more than enough time to figure this out. Go stand in the corner!

JEFFERY D. KOOISTRA ■

No new findings will ever be made if we rest content with the findings of the past. Besides, a man who follows someone else not only doesn't find anything, he is not even looking. "But surely you are going to walk in your predecessors' footsteps?" Yes indeed, I shall use the old road, but if I find a shorter and easier one I shall open it up. The men who pioneered the old routes are leaders, not our masters. Truth lies open to everyone. There has yet to be a monopoly of truth. And there is plenty of it left for future generations too.

— Seneca (4 BC - AD 65)
(Submitted by Ted Truscoe)

I don't want to achieve immortality through my work. I want to achieve immortality through not dying.

— Woody Allen

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UPCOMING EVENTS Anthony Lewis

29 Oct - 1 Nov 1998
WORLD FANTASY CONVENTION at Doubletree Hotel, Monterey, CA. Guest of Honor—Gahan Wilson, Special Guest— Frank M. Robinson; TM—Richard A. Lupoff. Registration—$125/£80. Info—WFC98, 555 Bryant Street #552, Palo Alto, CA 94301.

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13 - 15 November 1998
ORYCON 20 (Oregon SF conference) at Doubletree Portland-Columbia River, Portland, OR. Guests of Honor—Lois McMaster Bujold and Howard Waldrop; Editor Guest of Honor—Ellen Asher; Special Guest—Kathe Koja. Info—OryCon, Box 5703, Portland, OR 97228. (503) 283-0802. e-mail—jlorentz@spiritone.com

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13 - 15 November 1998
TROPICON XVII (southern Florida SF conference) at Doubletree Guest Suites, Cypress Creek, FL. Guest of Honor—Neil Gaiman, Artist Guest of Honor—Charles Vess. Registration (to SFSFS)—$25 until 31 October, $28 thereafter. Info—Tropicon XVII, c/o The Rawliks, 539 37th St, West Palm Beach, FL 33407. e-mail—Prawlik@concentric.net; URL—http://www.scifi.squawk.com/tropicon.html

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13 - 15 November 1998
WINDYCON XXV (Chicago area SF conference) at Hyatt Regency Woodfield, Schaumburg, IL. Guest of Honor—Allen Steele; Special Guest of Honor—Frederik Pohl; Artist Guest of Honor—Phil Foglio; Fan Guests of Honor—Barry & Marcy Lyn-Waitsman; TM—Christian Ready. Registration—$30 until 15 October, $40 at the door. Info—Windycon XXV, Box 184, Palatine, IL 60078-0184. e-mail—windycon@windycon.org; URL—http://www.windycon.org

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13 - 15 November 1998
PHILCON '98 (Philadelphia area SF conference) at Adam's Mark Hotel, Philadelphia, PA. Special Guest of Honor—Walter Jon Williams. Info—PhilCon 98, Box 8303, Philadelphia, PA 19101. (215) 957-4004. e-mail—philcon@netaxs.com; URL—ttp://www.netaxs.com/~philcon

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27 - 29 November 1998
CONCAT 10 (Knoxville area SF conference) at Radisson Summit Hill, Knoxville, TN. Guests of Honor—Jeanne & Spider Robinson: Artist Guest of Honor—Darryl Elliot: Special Guest of Honor—Rick Shelly. Registration—$25 until 10 November, $35 at the door (limit of 500). Info: Concat 10, c/o Chloie. (423) 637-6564 or (423) 523-6986. e-mail: chloieA@aol.com; URL—http://www.members.aol.com/knoxsf/cradle/concat.html

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2 - 6 September 1999
AUSSIECON THREE (57th World Science Fiction Convention) at World Congress Centre, Melbourne, Australia. Guests of Honour—George Turner (in memoriam), Gregory Benford, Bruce Gillespie. Registration—$155 (A$200); supporting $35 (A$45).[These are the latest posted rates as of the time this column went to press.] Info—Aussiecon Three, GPO Box 1212K, Melbourne VIC 3001, Australia. US Agent—PO Box 266, Prospect Heights, IL 60070-0266. URL—http://www.aussiecon3.worldcon.org. ■

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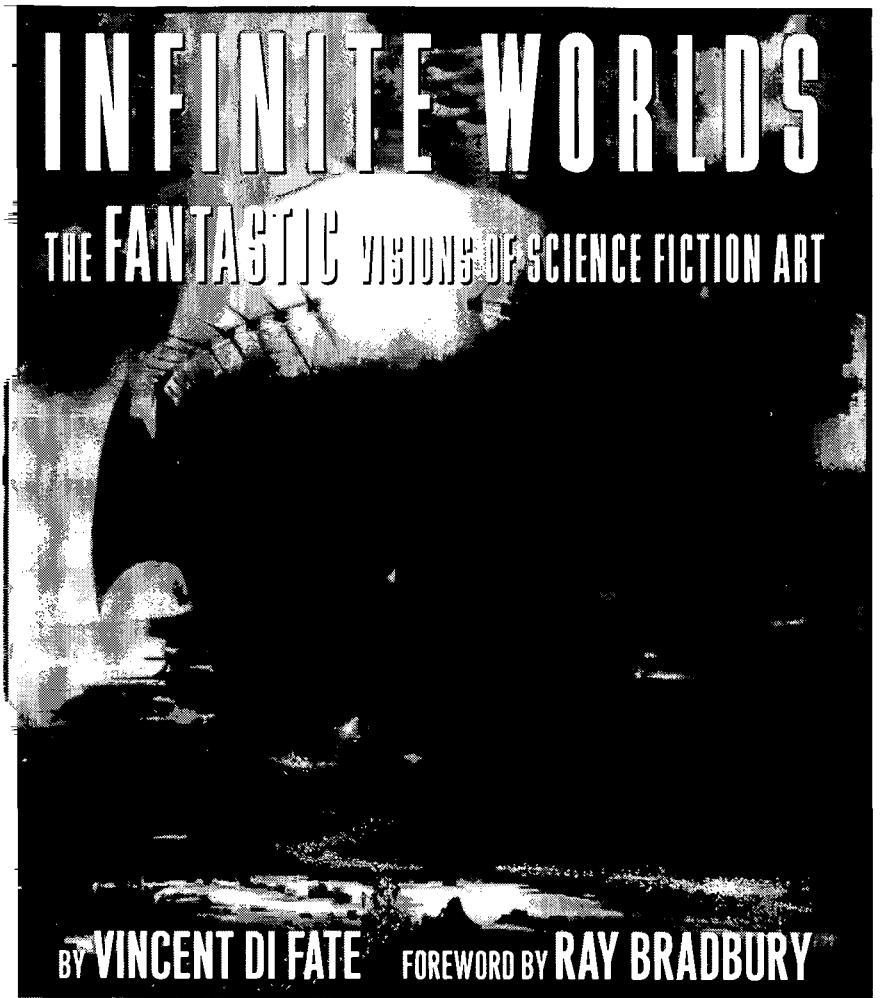

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TECHNOLOGY UPDATE

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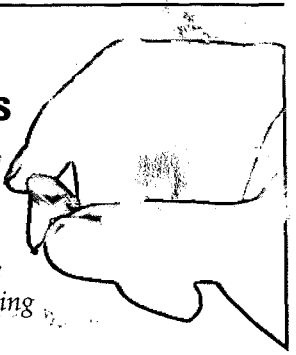

One day a friend asked my wife Jill if I had a hearing aid. "He certainly does," replied Jill, "Me!" After hearing about a remarkable new product, Jill finally got up the nerve to ask me if I'd ever thought about getting a hearing aid. "No way," I said. "It would make me look 20 years older and cost a fortune." "No, no," she replied. "This is entirely different. It's not a hearing aid...it's Crystal Ear!"

No one will know. Jill was right. Crystal Ear *is* different—not the bulky, old-styled body-worn or over-the-ear aid, but an advanced personal sound system so small it's like contacts for your ears. You may hear sounds your ears have been missing for years. Crystal Ear will make speech louder, and the sound is pure and natural.

It is smaller than the tip of my little finger and it's almost invisible when worn. Put it in your ear and its ready-to-wear mold fits comfortably. Since it's not too loud or too tight, you may even forget that you're wearing it!

You'll feel years younger! Wear Crystal Ear indoors, outdoors, at home and at work. Crystal Ear arrives ready to use, complete with batteries, two different fitting sleeves, a cleaning brush and even a carrying case. Crystal Ear is a breakthrough advance in the hearing device field. It is made in the USA, using state-of-the-art micro-manufacturing techniques that cut costs dramatically—savings that we can pass on to you.

Don't be fooled by high prices. No hearing device, no matter how expensive, can eliminate background noise, despite claims by the manufacturers. Crystal Ear does not promise miracles—just an affordable, sound solution to many common hearing problems.

Risk-free. Crystal Ear comes with a 90-day manufacturer's limited warranty as well as our risk-free home trial. If you're not satisfied, return it within 30 days for a full refund.

DON'T TAKE OUR WORD FOR IT...

"My father spent over $5000 on another brand. I showed him my Crystal Ear, he tried it, and he decided it worked better than his brand, even though it was a small fraction of the cost!"

—A satisfied Crystal Ear user

Results not typical.

Crystal Ear®:

Three credit-card payments of $99.95 $19 S&H

If not purchasing a pair, please specify right or left ear.

Please mention promotional code **4016-13932.**

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